Pest Management Alliance Project Final Report

Year 4

Contract number: 00-0210S

Contract title: **"To Promote a Reduced-Risk System of Almond Production Through Alternative Practices"**

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Acknowledgments

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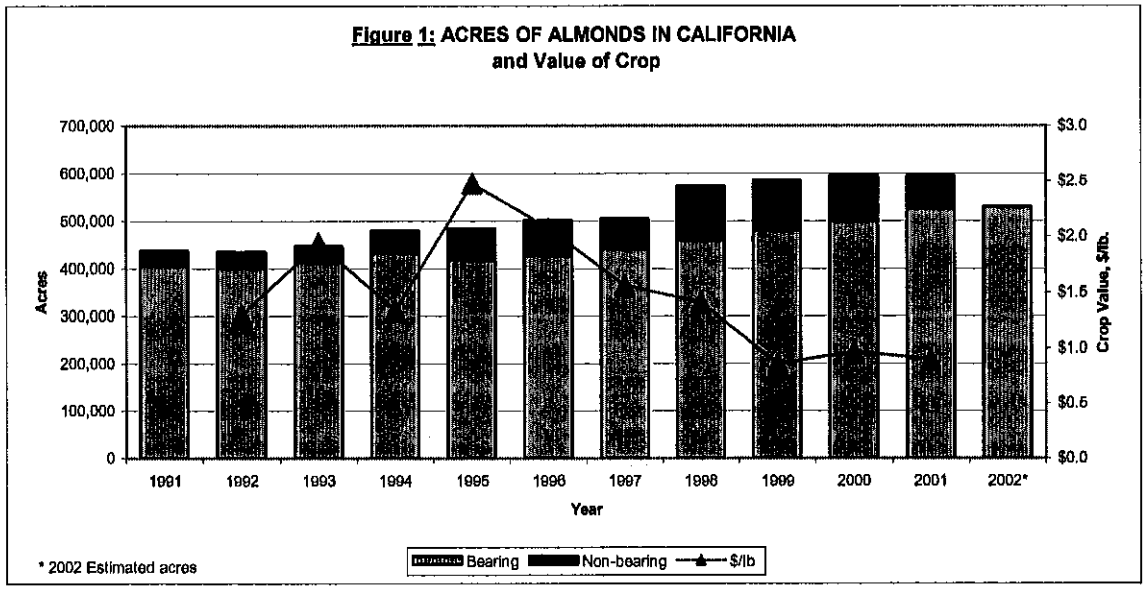
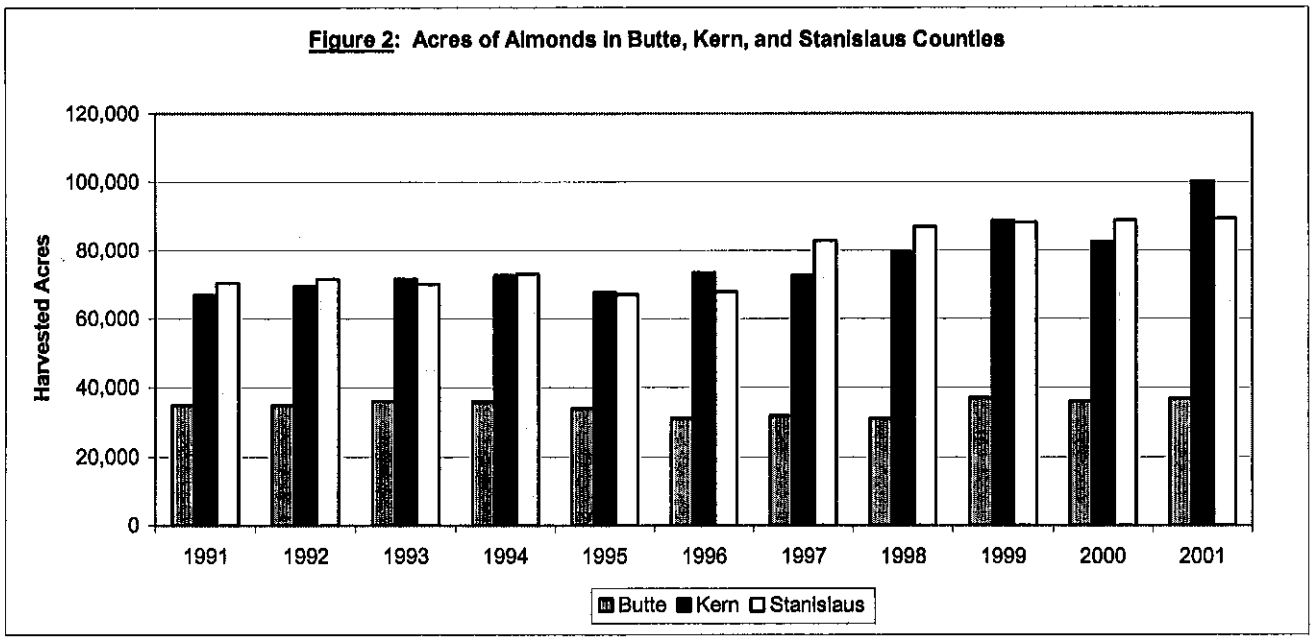
EXECUTIVE SUMMARY

The Almond Pest Management Alliance (PMA) was initiated by the Almond Board of California in 1998 to evaluate the possibility of reducing pesticide inputs in California almonds. The California Department of Pesticide Regulation (CDPR) awarded its first grant to the Almond PMA in 1998. The Alliance completed its fourth year of work on July 31, 2002. Almond PMA partners in Year Four were the Almond Hullers and Processors Association, the Community Alliance with Family Farmers, the University of California Statewide IPM Project, and University of California Cooperative Extension. This collaborative approach grew out of two major concerns: The implementation of the federal Food Quality Protection Act (FQPA) with possible loss of some traditional crop protection tools, and growing public concern over water quality standards in the San Joaquin River and Sacramento River watersheds, with possible links to pesticides used by almond growers.

Because of the enormous scope of the California almond industry that encompasses approximately 595,000 acres, (Figure 1) ranging from Bakersfield to Chico, and the wide range of pests and regional variables, the PMA set up and continues to use three regional projects. These projects are located in the Northern Sacramento Valley (Butte County), the Central San Joaquin Valley (Stanislaus County) and the Southern San Joaquin Valley (Kern County). Each project consists of an orchard that is divided into conventional practice treatment blocks and various reduced risk treatment blocks. Each project is directed by the local UCCE farm advisor and addresses regional pest concerns and growing conditions that would be relevant to local growers. The almond industry is closely examined in the three project areas as well as statewide (Figure 2).



The advisors employ a field scout who performs the extensive monitoring required. The target pests addressed across all three projects continue to be navel orangeworm (NOW), peach twig borer (PTB), San Jose scale, mites, and ants. Diseases, cover crops, and fertilizer applications are studied on a regional basis. Smaller satellite projects complement the PMA orchard demonstration sites by providing research about regional issues.



Other aspects of the Almond PMA include working closely with the PMA Advisory Team to stay abreast of current industry issues throughout the year, and to define research needs as they arise. In addition, pesticide use reports are summarized each year to determine the almond industry's contribution to the total pesticide load in the three regions of the project as well as the whole state. However, the most important part of the project may be to extend the most current information through field meetings and mailings such as newsletters.

Since 1998, the California almond industry has reduced its use of pesticides by almost 6 million pounds. Yields and quality have remained high, with production in 2002 being estimated at a record 940 million pounds. Although prices have been in a general decline for the last seven years, in 2001 almonds ranked 10th in gross value of agricultural commodities, bringing in $837,945,000.

After four years, the Almond PMA can conclude that this partnership approach has been successful on two levels: It has helped build an effective network of information gathering and sharing throughout the diverse and far-flung California almond industry, while building a knowledge base of scientifically valid research that will enable almond growers to make key informed decisions that affect pest management in an environmentally responsible manner.

The fourth year of the Almond PMA has also demonstrated the following:

- Extensive orchard monitoring is the key to the success of this approach.
- Reduced risk practices appear to be controlling the pests below economic damage levels.
- Other pests may begin to build populations due to the altering of spray programs.
- Growers are interested in reduced risk practices and continue to be proactive.

As the Almond PMA entered its fifth year on Aug. 1, 2002, its goals included:

1. Involve more PCA's and growers in monitoring during the crop season and through the dormant season.
2. Implement smaller, more frequent, more regionally based field meetings regarding reduced risk practices.
3. Create guidelines or protocols for reduced risk pest management in almonds based on what has been learned in the PMA project.
4. Use a continuing PMA as an umbrella sponsorship entity to continue IPM and related agricultural stewardship research

INTRODUCTION

The Almond Pest Management Alliance (PMA) was funded by a $99,000 grant awarded by the California Department of Pesticide Regulation (CDPR) for the crop year Aug. 1, 1998 to July 31, 1999. The proposal is titled "To Promote a Reduced-Risk System of Almond Production Through Alternative Practices". Since then, four more years of research and demonstration have been funded by the CDPR PMA grants with additional funding from the Almond Board of California.

Structurally, the Almond PMA is managed by a team composed of representatives from each of the identified organizations, as well as private Pest Control Advisors (PCA's.) The team meets on a quarterly basis to review the project's progress and make decisions about its future course. The Almond Board of California oversees the administrative functions.

The Almond PMA set these basic objectives at the beginning and they continue to be relevant through subsequent years of funding.

- Establish orchard sites in three different almond-growing regions to collect data regarding almond pest management practices that reduce environmental risks associated with pesticide use.
- Conduct extensive orchard monitoring and specific research activities that address localized pest control and almond production practices.
- Provide almond growers with updated information on available reduced risk pest control practices so they can make informed choices about alternatives.
- Promote and extend information to growers to ensure California almond growers understand the need for a reduced risk system that has the ability to reduce pesticides and sustain profitability.
- Evaluate the risk reduction achieved as a result of this project by producing a final report that includes not only a projection of the risk reduced, but a discussion of the costs and benefits of the solution and the practicality of adoption.

To complement the objectives involved in the Almond PMA, tasks were designed to accomplish the goal of reducing pesticide use. Task 1 is to assemble an Advisory team that meets and keeps the project moving forward. Tasks 2 through Task 4 consist of the continuation of the PMA sites in Butte, Kern, and Stanislaus counties respectively. Task 5 is to research pesticide use in each of the regional PMA sites. Outreach and education to the growers are Task 6, being field meetings, newsletters, and news articles relating to the Almond PMA. Finally, Task 7 is the project evaluation.

The PMA views this project as an efficient way to bring together many years of research and demonstration which have been spent on alternative and reduced risk management techniques. By applying the vast body of knowledge accumulated over the years by the University of California the Alliances goal is to study reduced risk practices on a large scale.

The Almond Board of California has been supporting an Integrated Pest Management (IPM) system for more than 25 years These projects have helped reduce the use of pesticides through such studies as: Navel Orangeworm Orchard Sanitation and Early Harvest, Reducing Dormant Spray Hazards, Pheromones for Peach twig borer, and Alternatives for Soil Fumigation with Methyl Bromide. Results of these research projects are available from the Almond Board of California. The Board has also received an "IPM Innovator Award" from CDPR for its innovative leadership role in the field of IPM.

Dr. Lynne Epstein, UC Davis, at a May 2000 California regulatory conference, described the almond industry as one of the "great examples of an IPM success story." The UC Statewide IPM Project is well recognized for its national leadership on IPM. The IPM Project publishes the well-respected *IPM for Almonds Manual.* This publication states, "A good IPM program coordinates pest management activities with cultural operations to achieve economical and long-lasting solutions to pest problems." The PMA has taken this quote to the field and reduced risk farming practices take in cultural and long-lasting solutions seriously.

Task 1: Almond PMA Advisory Team

Task 1 is planning and leadership by the PMA Advisory Team. The Advisory Team is responsible for the cooperative decision-making which leads to the design and implementation of new methods to approach reduced risk practices. Communication between stakeholder groups is important to achieve these results. The PMA Advisory Team meetings bring together representatives from the three almond growing regions to ensure local grower concerns are incorporated into PMA project plans. The Advisory Team met on March 12, 2002 in conjunction with a PMA workshop that included all PMA grant projects. The workshop and meeting were held at the EPA building in Sacramento. The Advisory Team discussions included site updates, planning field days, and pesticide use reduction efforts directed at specific areas of the state. Review of Pesticide Use Reports has shown that Kern County's use of pesticides is not declining at the rate of other areas of the state. In addition, other groups have requested almond monitoring protocols for reduced risk farming systems, so the PMA team decided to refine and publish the protocols we have been using. The Advisory Team met again on September 19 in Modesto. Topics discussed were dormant spray field days, newsletter publication, and the future composition of the partners of the almond PMA. The advisory Team is essential for the success of the Almond PMA by providing leadership, direction, and expertise.

Task 2: Butte County Almond Pest Management Alliance
2002 Final Report
Year 4

Joe Connell, UCCE Farm Advisor, Butte County; Carolyn Pickel, Area IPM Advisor; Sara G. Smith, Field Scout, UC IPM; Nick Bertagna, grower; Richard Gregor, pest control advisor.

Butte County Objectives:

1. To scientifically evaluate the success and profitability of managing arthropod pests with less broadly toxic pesticides in a commercial almond orchard.
2. To demonstrate and facilitate adoption of integrated pest management monitoring techniques and decision-making processes to growers and pest control advisors.

This report summarizes our progress as through the fourth year of the project. The Butte County site is an orchard of 49 acres and originally contained four different treatment blocks plus an untreated check of ½ acre added in 2001. The PMA I block is a "typical" soft treatment with *Bacillus thuringiensis* used for lepidopteron control, the OP Dorm block is treated with Diazinon plus oil during dormancy, and the OP Dorm/HS block is treated with Diazinon plus oil during hullsplit as well as during dormancy. The PMA II block is the grower's standard practice. However, no insecticide treatments were applied to the PMA I in 2001, so it was the same as the untreated control. In 2002, chemical inputs were reduced even more, making this orchard an excellent demonstration of the long-term effects of an economically viable and environmentally friendly farming system. Diazinon plus oil was applied to the OP Dorm and the OP Dorm/HS blocks for a total of 10 acres. The OP Dorm/HS block did not receive an organophosphate hullsplit spray this year, as it was unnecessary. Essentially, in 2002, the orchard contained 2 reps of the dormant treatment (OP Dorm I & II), and 2 reps of reduced risk (PMA I & II). The 0.5 acre untreated control was not used since the PMA blocks were also untreated. Pest control was supplemented with releases of three species of beneficial insects. The entire orchard was treated with a reduced risk fungicide and also an herbicide for weed control. Treatment details are as follows:

1. PMA I & II, 39 acres total (growers standard practices- no sprays)

2. OP Dorm I & II, 10 acres total (Organophosphate used during dormancy)
   - Sprays: Diazinon, @ 4 pints/acre, plus Supreme oil @ 4 gals/acre. 1-10-2002.

Beneficial insect releases were made in the orchard starting April 15, 2002. Lacewing species, *Trichogramma* species, and *Goniozus legneri* were released approximately every week throughout the summer until harvest. Total seasonal releases for Lacewings were 2,000/acre, *Trichogramma* were 100,000/acre, and *Goniozus* were 1,000/acre.

Fungicide treatment and weed management was the same across the whole orchard, as follows:

- Feb 21 & Mar 5, 2002: Vanguard @ 5 oz/acre
- Strip treatment in Feb and July: Roundup @ 2 pints/acre and Goal @ 5.5 oz/acre
- Middles treatment in Aug and Sept: Roundup @ 3 pints/acre

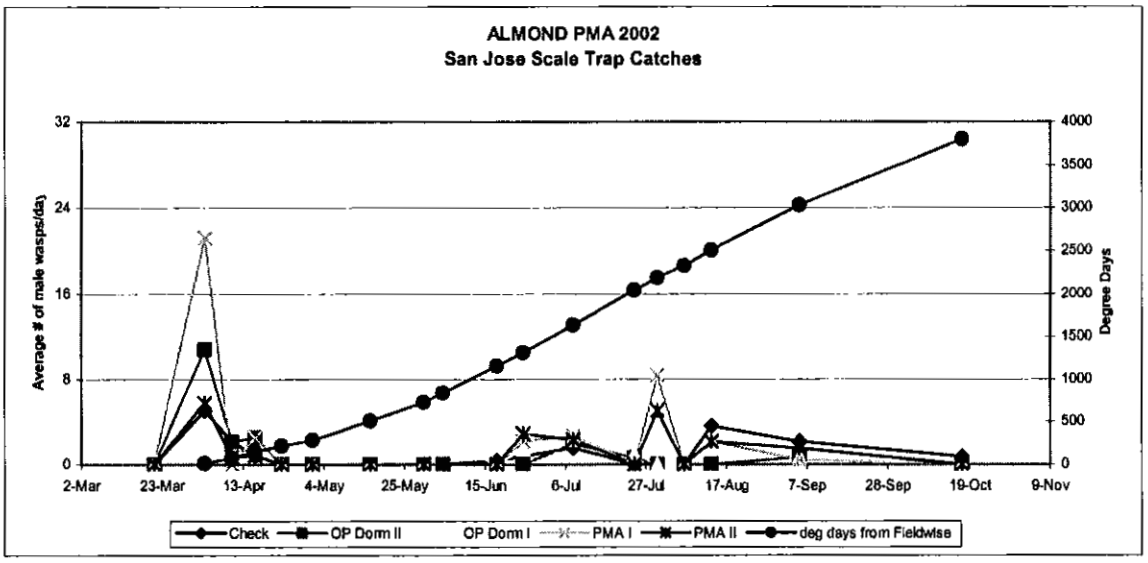
Additional weed control was achieved by mowing. The orchard floor was mowed on every other row 6 times.

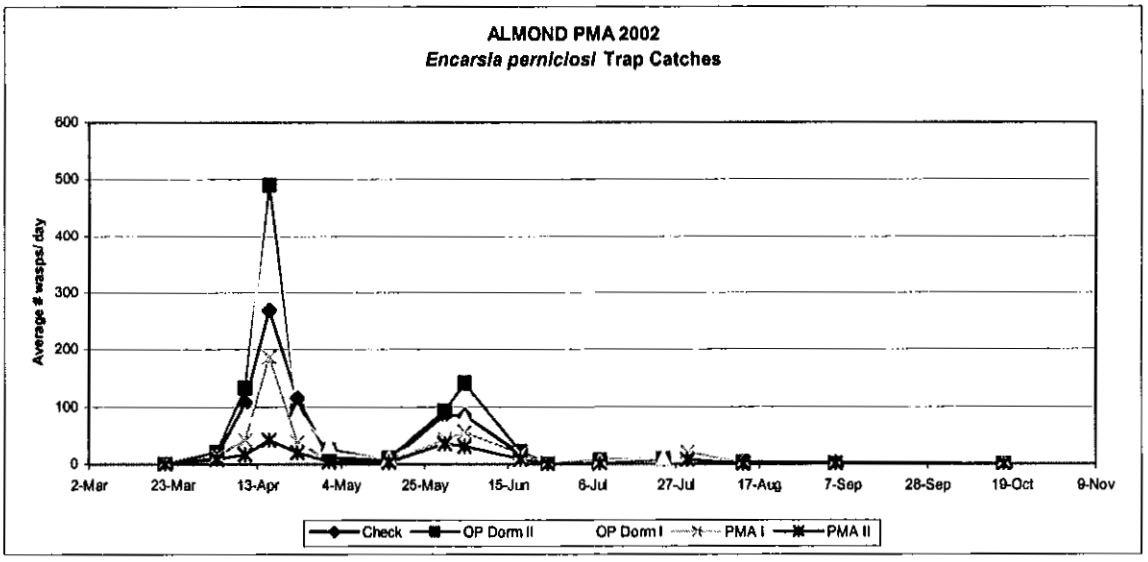
Monitoring:

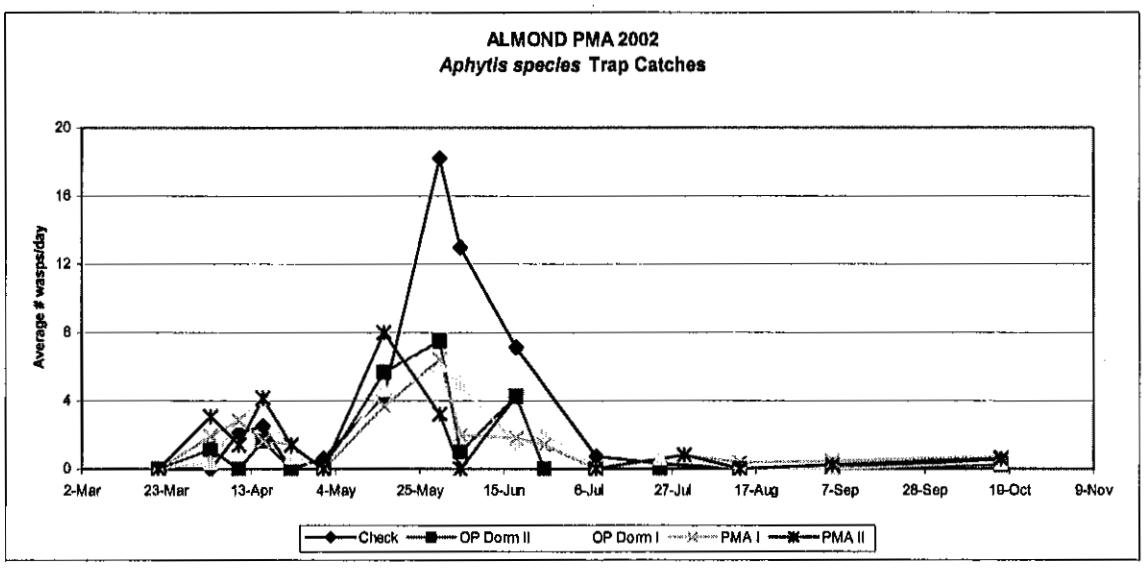
This trial is monitored for peach twig borer, naval orangeworm, web spinning mites, San Jose scale adult males, and San Jose scale parasitoids (*Encarsia* and *Aphytis*), and ants from late winter through October. In each treatment pheromone traps were placed in the center of the block and monitored weekly for peach twig borer, San Jose scale, and naval orangeworm. Lures were changed as recommended by the manufacturer. Weekly trap counts were shared with growers, Farm Advisors, and PCA's. Degree-days for each of these pests were calculated to determine biofixes and to provide treatment timing for those in the area who might need it. Weather data and degree-day calculations were obtained at no cost from www.Fieldwise.com using the Durham station. Beginning in June, plots were monitored every other week for mites using the presence / absence sampling technique. Ants were also monitored and identified in May using the hot dog baiting method.

San Jose scale pheromone traps were placed in the orchard on February 22 and checked weekly for the presence of male scales. The SJS traps were also checked for parasitic wasps of the scale, *Encarsia perniciosi* and *Aphytis species* that are also attracted to the SJS lure and get stuck on the trap. The first scales were found in the traps April 3 in large numbers, and that turned out to be the highest population all season. After this date, the male scale reappeared sporadically in low numbers in July. Parasitoids were also

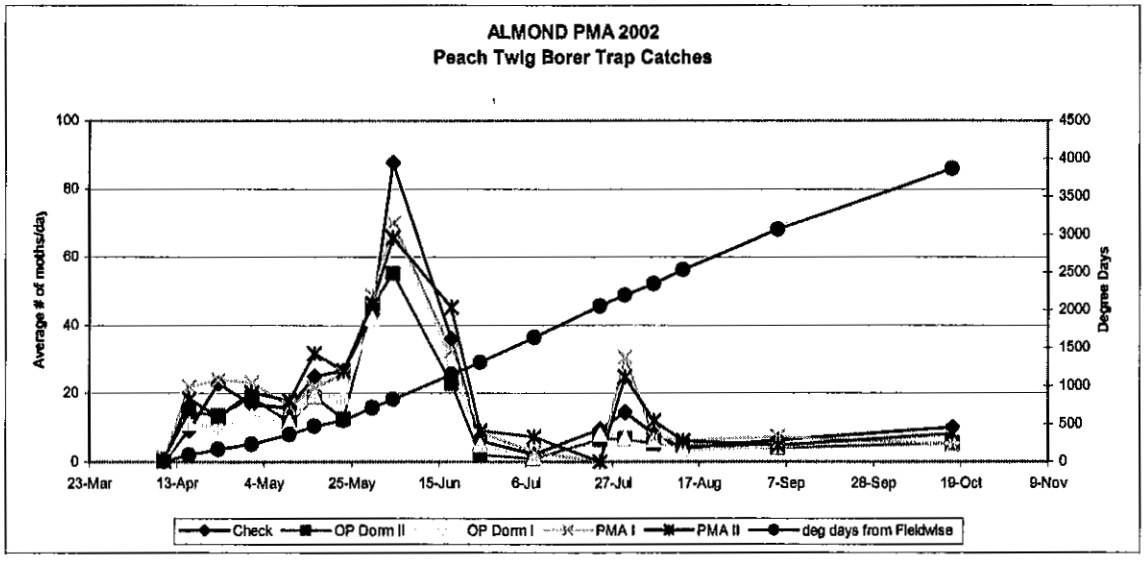
detected on the traps beginning April 3 and were most always present whether or not scale was caught on the traps.



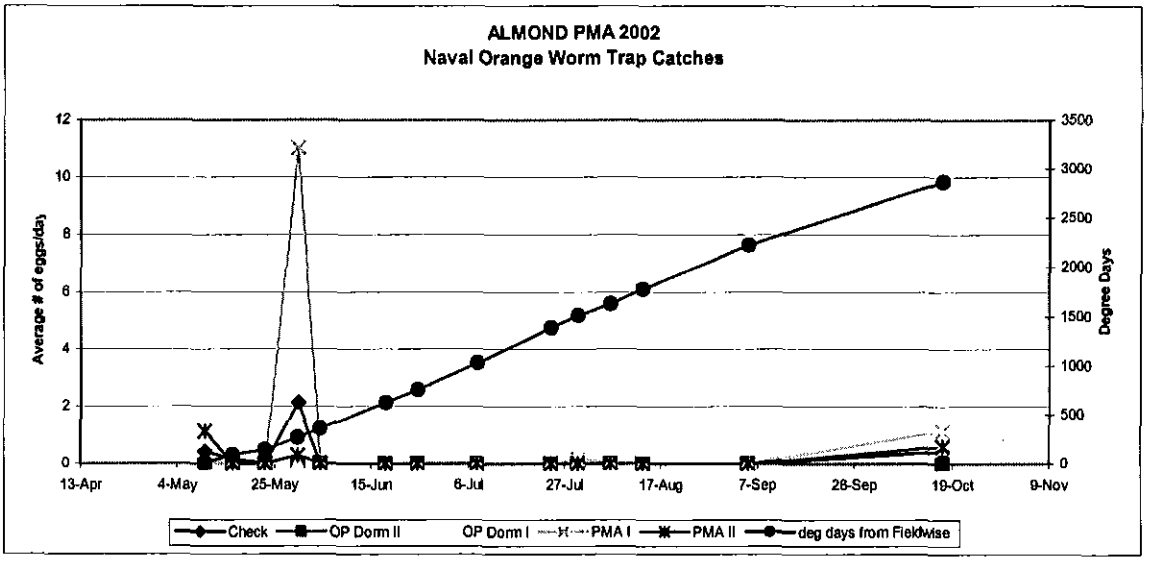




PTB pheromone traps were hung March 21 and checked twice a week to establish the first biofix. The upper portion of the canopy was inspected for shoot strikes at the beginning of PTB generations. Five trees per treatment block were examined. Shoots with damage were clipped with pole pruners and split down the center to verify presence and identification of larvae.



The NOW egg traps were filled with ground almond bait and placed in each treatment block on May 1. The first naval orangeworm egg was detected on May 10. Eggs were cleaned off the trap whenever they were found in order to determine the weekly number of eggs. After that, there was one main population peak on May 30, then there were no more NOW eggs found until after harvest.



Cumulative trap catches through October 17, 2002 for peach twig borer, San Jose scale males, *Encarsia, Aphytis,* and naval orangeworm eggs for the four treatments and check are listed below. It is worth noting that both OP Dorm treatment blocks had one spray of organophosphate and the other blocks had zero sprays.

ALMOND PMA 2002 Cumulative Trap Catches

	PTB	NOW	SJS	*Encarsia*	*Aphytis*
OP Dorm II	2133	0	220	7796	290
OP Dorm I	2353	25	490	6790	295
PMA I	2852	126	415	3326	305
PMA II	3082	36	216	1585	345
Check	3044	37	215	5795	560

Beginning in June, mites were monitored every other week using the presence / absence sampling method. When using the presence / absence method, leaves are examined for the presence of any webspinning mites regardless of species. If a leaf has one or more mites or mite eggs, it is rated as a (+). If no mites or eggs are present, then it is given a (–) rating. Predatory mites and other beneficial insects such as six spotted thrips are also rated in the same manner. In this trial, fifteen leaves from five trees in each block (75 leaves per block) were examined for mites. At the start of mite sampling, trees in possible hot spots were monitored, and as the populations increased, trees were chosen more randomly. Mite populations did not start to increase until late July, and the number

of predatory mites and beneficials increased along with the damaging mites. No treatment was applied to control mites so as not to disrupt the beneficial insects.

ALMOND PMA 2002 Cumulative Number of Leaves with Mites		
	Web spinning Mites	Predators/Beneficials
PMA I	15	16
PMA II	22	23
OP Dorm I	34	19
OP Dorm II	16	17
Check	9	17

In previous years, ants were monitored to determine species in each of the treatment blocks, but no attempt was made to quantify the ant populations. The species found in the orchard were Southern Fire Ant and Pavement Ant. The harvest sample from 2001 was damaged mostly by ants even though the damage level was very low (1% or less). Therefore, in May 2002, an attempt was made to measure population levels and densities of ants throughout the entire orchard. Vials were numbered, baited with pieces of hot dog and placed, open, at the base of every 15th tree. This was done in every fifth row. The vials were capped, collected, and frozen after 1.5 hours. Later, the vials containing ants were counted to determine whether any areas of the orchard would have to be baited for ant control. There are no available treatment thresholds, so it wasn't possible to determine the need for treatment. The data shows a range of population densities that could be due to location in the orchard.

ALMOND PMA 2002 Ant sampling results			
	Total # of vials	# Vials with ants	% Ants
PMA I	20	13	65
PMA II	40	16	40
OP Dorm I	14	9	64
OP DormII	11	3	27

On July 18, 2000, a leaf sample was collected for analysis of nutritional levels. Laboratory analysis were performed to determine the levels of nitrogen, phosphorus, potassium, magnesium, calcium, sodium, sulfur, zinc, manganese, copper, iron, boron, molybdenum, and aluminum. The test results showed that nitrogen was low but not deficient at 2.17 %, potassium was slightly deficient at 1.32%, and manganese was quite

deficient at 13 ppm. The grower can use this information to correct nutritional disorders with fertilizer.

Dormant spur sampling is conducted before the growing season begins, most recently on Jan 3, 2002. Spurs were taken from each treatment block and inspected for mite eggs, predatory mites, San Jose scale, parasitized SJS, and European Fruit Lecanium crawlers. Counts were tabulated and compared to the three previous years of the PMA project to determine if levels are increasing or decreasing and if the treatment threshold for any of the listed insects had been reached.

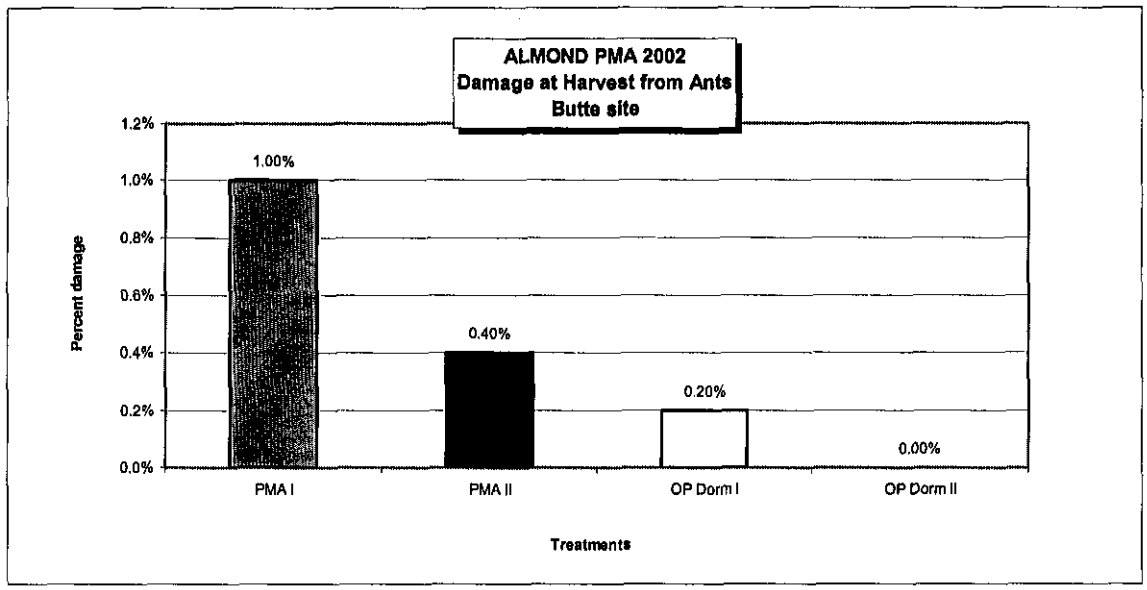
ALMOND PMA 2002
Counts from Dormant Spurs for Four Consecutive Years

	Date	PMA II	PMA I	OP Dorm I	OP Dorm II
SJS (Live)	12/7/1998	5	2	0	6
	12/3/1999	15	11	3	3
	12/8/2000	5	1	1	2
	1/3/2002	5	9	0	1
Parasitized SJS	12/7/1998	0	0	0	0
	12/3/1999	5	6	0	1
	12/8/2000	2	1	0	0
	1/3/2002	0	0	0	0
Mite Eggs	12/7/1998	68	69	54	53
	12/3/1999	17	18	8	8
	12/8/2000	4	2	3	7
	1/3/2002	3	2	6	9
Predatory Mites	1/3/2002	1	0	0	1
EFL Crawlers	12/7/1998	N/A	N/A	N/A	N/A
	12/3/1999	8	15	0	0
	12/8/2000	10	0	0	0
	1/3/2002	10	7	0	1

Harvest Reject Levels

At harvest, 100 almonds were randomly collected from each of five trees in each treatment block for a total of 500 per treatment. Nuts were inspected for damage, and the

damaging insect identified. Percent damage to each treatment block was calculated. This year, there were very low damage levels from ants in the harvest sample and no damage at all from other insect pests.



Costs Associated with Two Pest Management Programs

Product costs are directly from the grower's records and are similar to those listed on the UC IPM website, http://www.ipm.ucdavis.edu/

ALMOND PMA 2002 Treatment Costs

	# Acres	Date	Product	Product cost/acre	Application cost/acre	Total cost/acre
PMA I & PMA II	39	2-21-02	Vanguard	$8.17	$18.00	$26.17
OP Dorm I & OP Dorm II	10	1-10-02	Diazinon + Oil	$18.83 $10.30	$18.00	$47.13
		2-21-02	Vanguard	$8.17	$18.00	$26.17

Conclusions

We had another successful season with the Butte County Almond Pest Management Alliance. Our spring meeting was well attended and interest in adopting reduced risk practices remains in the forefront for growers. The key to successful reduced risk

practices is intensive monitoring. We will continue to monitor to follow insect populations and to ensure that the potential for economic damage is minimized.
The Almond Pest Management Alliance has been active for four years in California. Interest in reduced risk farming practices has increased as the economic viability of the methods has been demonstrated. The PMA has been beneficial for growers, industry, and the environmental and regulatory community.
The Butte County Almond PMA has been quite successful in showing that there is no more pest damage in the PMA blocks which had zero pesticide applications, than there is in the treatments with organophosphate sprays. The PTB trap catches in all of the treatments increased each year up to the third year of the project the fourth year the trap catches decreased again. The trap catches in the organophosphate treatments are not lower than the non-sprayed treatments and do not stay lower than the other treatments as would be expected. Even though we see increased trap catches over the first three years we did not see increased damage in any of the treatments.

Task 3: Kern County Final Report

Pest Management Alliance Project

Mario Viveros, Walt Bentley,
Peggy Schrader and Minerva Gonzalez

Introduction:

The purpose of this project was to demonstrate a reduced pesticide input versus a conventional pesticide management program in young orchards for the Southern end of the San Joaquin Valley. This project was established four years ago in a 160-acre block that was made up of 80 acres of "hard shells" (Butte – Mission – Padre) and 80 acres of "soft shells" (Nonpareil – Fritz – Sonora). Both "hard and soft" shell varieties were divided into two (20 acres each) conventional and two (20 acres each) reduced input management plots. For the 2001 and 2002 season each of the plots in both conventional and reduced input were divided into dormant and non-dormant spray subplots. Thus, the treatments included: 1) conventional dormant, 2) conventional non-dormant, 3) reduced dormant, and 4) reduced non-dormant.

This report is for data obtained in the 2002 season. It doesn't include information from 1999, 2000 and 2001 seasons.

Cover Crops:

The barley cover crop was selected because of the saline-alkali and poor drainage conditions of the PMA orchard soil. The barley was seeded in every middle on both "soft" and "hard" shell blocks, at a rate of 80 lbs. per acre. The seeding was done in December, but the seed did not germinate due to lack of winter rains.

Pest Monitoring:

The setup for pest monitoring was similar to that in year 2001. The reason being that both conventional and reduced input management treatment was subdivided into dormant and non-dormant subplots.

San Jose Scale (SJS). This pest was monitored using twig samples, pheromone lures and double-sided sticky tape. The overwinter population on fruiting wood was monitored in December. Twenty spurs were gathered from each block, concentrating on the susceptible varieties, Padre, Sonora and Thompson. Ten spurs were gathered low and ten high on the tree. The fruiting wood was again evaluated in March taking five twig samples in each treatment. The adult population was monitored by placing one sticky trap with a pheromone lure in each plot. The trap was placed on the tenth tree in from the end, and six or seven feet high in the northeast quadrant of each tree. The trap was placed on February 11 and was monitored weekly until the end of November. Pheromone lures were replaced every four weeks. Adult San Jose moths were counted as

well as the *Encarsia* and *Aphytis* adults. The crawlers were monitored by using double-sided sticky tape that was placed in four trees surrounding the tree that contained the pheromone traps. Tape was placed March 29, 2002 and was monitored weekly for presence-absence until the biofix occurred.

Peach Twig Borer (PTB). This pest was monitored by placing pheromone traps and by larva emergence from hibernacula. The traps were used for monitoring the adult population. They were placed in the tenth tree in from the end, six or seven feet high in the northeast quadrant of the tree. The traps were placed March 29, 2002 and their pheromone lures were replaced every eight weeks.

The PTB larvae emergence was determined by collecting rust-colored hibernacula (minute chimney-like piles of frass and sawdust) from crotches (branch angles) of two-year-old trees. With a grafting knife, a pie-shaped wedge containing the hibernacula was cut from tree crotches and placed into a vial. Ten hibernacula were collected from 10 different areas of an orchard located 9 miles from the PMA orchard. Under the microscope, the hibernacula was opened with a probe and the presence or absence of the larvae was noted. Absent larvae meant it had emerged. Therefore emergence was determined by the number of absent larvae. Samples were taken, every five days, from early February through early-March.

Navel Orangeworm (NOW). This pest was monitored with egg traps and winter sanitation. One NOW egg trap was placed in each plot on March 29, 2002. It was placed in the tenth tree in from the end in the north side of the tree and six or seven feet high. The traps were black and contained an almond meal mixture.

Winter sanitation was evaluated on February 12, 2002 by counting the number of nuts left from harvest. These nuts are called mummies. Forty-five trees in each plot were selected and the number of mummies were counted in each tree.

Mites. This pest was monitored with soil and leaf samples. The soil samples were taken in the winter and leaves were sampled during growing season. Soil monitoring to determine the overwintering female web-spinning mite began January 16, 2002 and continued with weekly samples until April 11, 2002. Soil samples were taken from the base of the trees and placed in eight ounce Styrofoam cups that were filled to the rim. Then, they were placed on a sticky card and left at room temperature for two weeks. After two weeks, the overwintering female mites emerged from the soil and got stuck to the cards. The sticky cards were then read and the overwintering female mites were recorded.

Leaf monitoring for mites on Nonpareil and Butte varieties began on March 13, 2002. Leaf samples were taken at random from five trees in each plot. The tree location changed every week. On one week the trees were located at the extreme ends of the orchard, but on the following week, they were located through the middle of the two blocks. Ten leaves were selected from each tree. Initially, only interior leaves were selected, however, by mid-May, half of the leaves were selected from the interior and

half from the exterior of the tree. Leaves were brought back to the lab, in an ice chest, and examined under a microscope. The presence-absence method was used. Only web spinning mites were considered. European red, predatory mites and sixspotted thrips were noted.

On March 7, 2002, twigs were selected from trees to evaluate the movement of overwintering females. Five twigs were gathered from five different trees in each plot. Twigs were selected from inside major branches and only the lower parts of the branches were sampled. The twigs were brought back to the lab and examined under a microscope.

Ants. This pest was monitored by the "hot dogging" method on May 14, May 31, July 1, Aug. 7 and Sept. 20, 2002. Half-inch hot dog slice (Bar-S brand containing beef, pork, and chicken) was placed in a snap-cap vial. These vials were distributed in the orchard in the morning when ant activity is at its maximum. The vials stayed on the orchard floor for a period of two hours, then picked up and stored in the freezer until counting. The ants were removed from vials by washing them onto a petri dish. The ants were separated with a glass rod and counted.

Nutrients. The nutrient levels were monitored by June-July leaf samples. The samples were washed in distilled water. They were allowed to dry and then ground through a Wiley mill. The samples were then sent to the ANR Laboratory at U.C. Davis for analysis.

Production. Yields of Nonpareil and Butte from both conventional and reduced input systems were taken at harvest. In addition, yields were taken from dormant and non-dormant sprayed plots from both conventional and reduced input systems.

Treatments:

Dormant Sprays. The conventional and reduced input systems were subdivided into sprayed and non-sprayed. The conventional sprayed treatment was sprayed with five pints of Diazinon® plus six gallons of oil mixed with 250 gallons of water per acre. The reduced input treatment received six gallons of oil in 250 gallons of water per acre. The spray was applied December 18, 2002. The complete spray program can be found in Appendix A.

Winter Sanitation. By February 7, both conventional and reduced input treatments were mechanically shaken for mummy removal.

May Spray. This spray was done for the control of NOW and PTB. The reduced dormant and reduced non-dormant treatment were sprayed with Confirm® at 16 oz. per acre in 250 gallons per acre. The PTB biofix was April 3 and NOW was April 10. The spray was done on May 13, 2002. At this time, we had accumulated 523 Degree-days for PTB and 307 Degree-days for NOW.

Hull Split Spray. This spray was done on July 9, 2002, at the on-set of hull split for the control of NOW. The conventional (dormant and non-dormant) was sprayed with Imidan® 5 lb per acre in 250 gallons per acre.

Mite Sprays. The conventional (dormant and non-dormant) was sprayed with the following: 1) 4 gal. oil on March 21 and 28, 2) AgriMek® 10 oz. on May 12 and 3) 2 gal. oil on May 1, 2002. Reduced-dormant AgriMek® at 10 oz plus 2 gal. of oil per acre. Reduced non-dormant was sprayed with AgriMek® 10 oz. plus 2 gal. of oil per acre. This was done by spraying every other middle. The other sprays were complete across the block. The amount of water for all sprays was 250 gallons per acre.

Ant Sprays. The conventional-dormant was sprayed on Aug. 7 with 4 pt. Lorsban® in 100 gallons of water per acre. Reduced-dormant received 1.5 lb. Esteem® per acre. Reduced-nondormant received one pound of Clinch® per acre.

Results:

San Jose Scale. The San Jose Scale continues to increase in the plots that were left unsprayed for two dormant seasons. During the growing season, scale was found on leaves and along the nut suture. Also, heavy infestation was found on the spurs. Table 1 shows the percent of spur infestation on December 10 and March 18 from treatments that received a dormant spray and non-dormant spray.

Table 1. Percent of spur infestation on December 10 and March 18 from dormant and non-dormant treatment.

Treatment	12-10-02	03-18-02
Reduced Input (oil)	5	0
Conventional (oil & Diazinon®)	0	0
Reduced (no dormant)	8	60
Conventional (no dormant)	21	60

The SJS adult populations from plots that receive no dormant spray and from plots that received a dormant spray are found in Figures 1 and 2. Figure 1 shows the adult population from plots that received no dormant spray and Figure 2 shows SJS populations that received a dormant spray. Both show the same population pattern in the growing season. These are two generations in both figures and both have the same population numbers. It is important to note that SJS spur infestation is a better indicator of orchard infestation than adult population trapped on a pheromone traps. The traps only show the presence of SJS adults.

Figure 1. Average number of male SJS per trap, where no dormant spray was applied, from February to November.

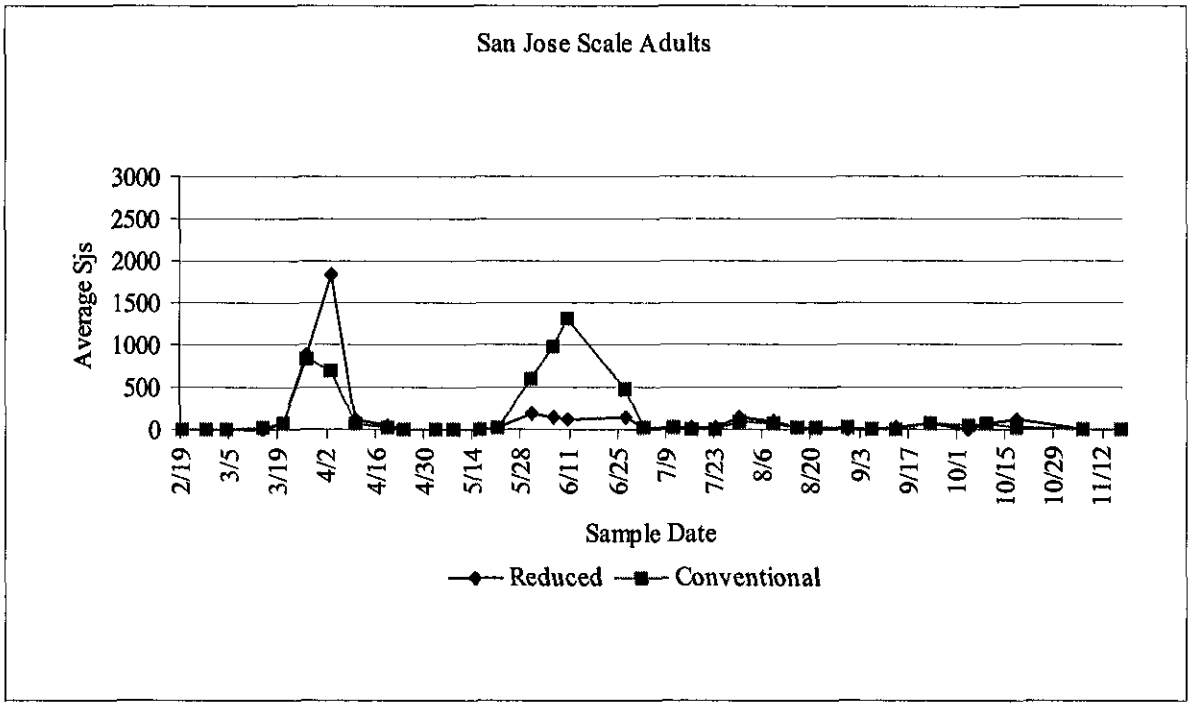
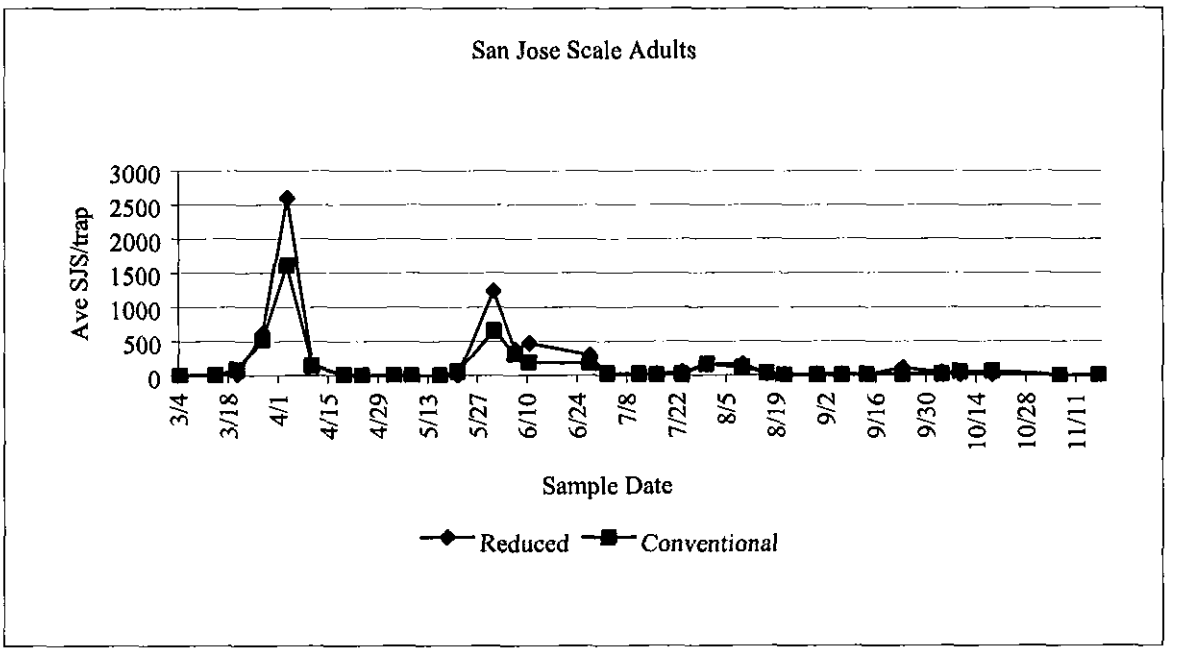


Figure 2. Average number of male SJS per trap, where dormant spray was applied, from February to November.


San Jose Scale Adults
Ave SJS/trap
3000
2500
2000
1500
1000
500
0
3/4
3/18
4/1
4/15
4/29
5/13
5/27
6/10
6/24
7/8
7/22
8/5
8/19
9/2
9/16
9/30
10/14
10/28
11/11
Sample Date
Reduced
Conventional

Peach Twig Borer. The 2002 PTB emergency (Figure 3) was earlier than the emergence in 2001. This was due to warm temperatures (Figure 4) in February.

Bloom sprays for disease control were not needed during the 2002 bloom season. The weather at this time was warm and dry. However, if sprays had been necessary, one could have included the pesticide Bt for PTB control since PTB emergence and bloom development coincide with each other.

Figure 3. Peach Twig Borer emergence for 2002.

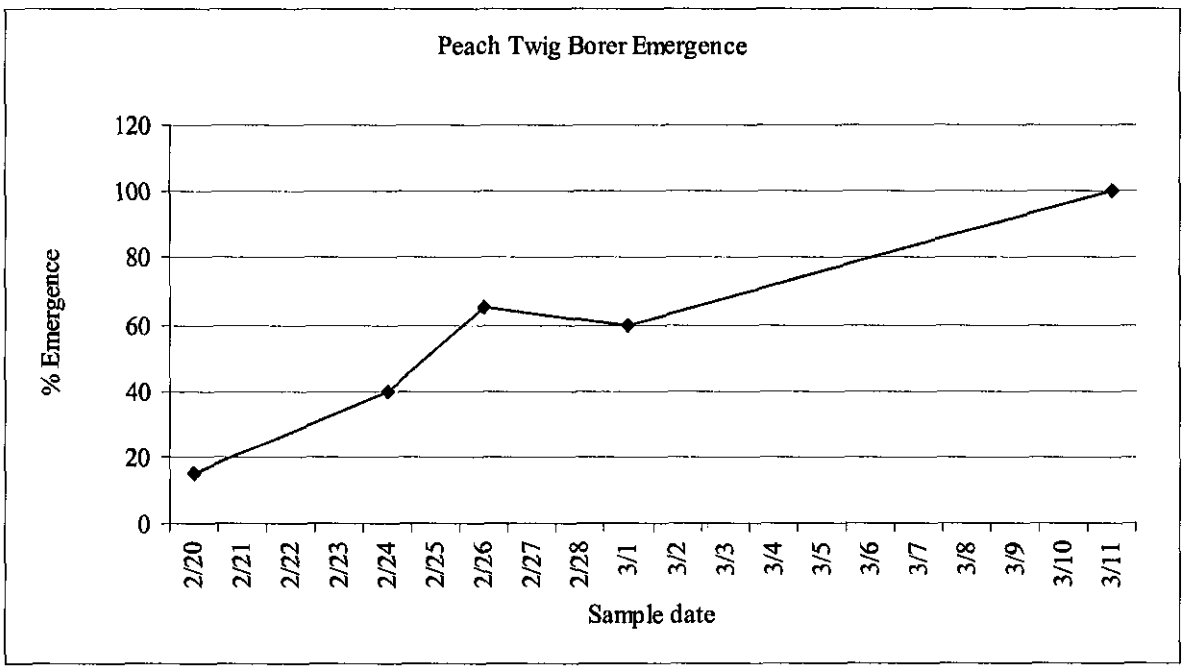


Figure 4. Daily high temperatures in February – March for 2001 and 2002 during PTB emergence.

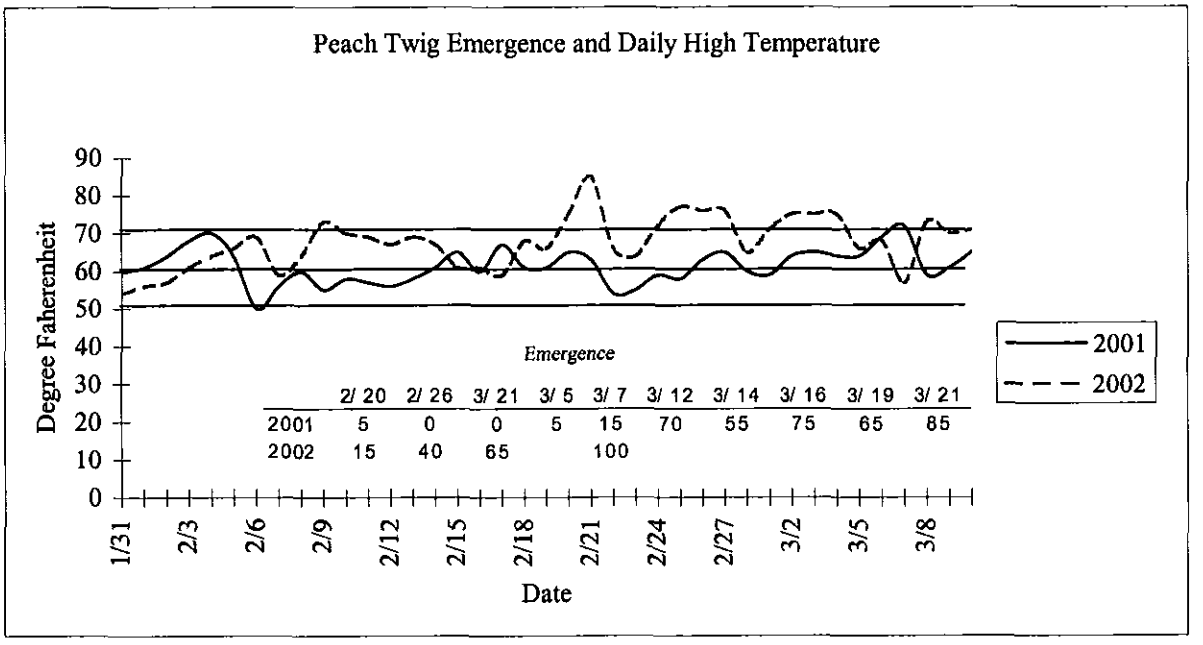


Figure 5 shows the adult population of PTB from February to November in the no dormant spray for both conventional and reduced input treatments. The two populations of PTB (conventional and reduced) were the same and the same thing can be said about the dormant spray treatment (Figure 6).

Figure 5. Average number of PTB per trap, where no dormant spray was applied, from February to November.

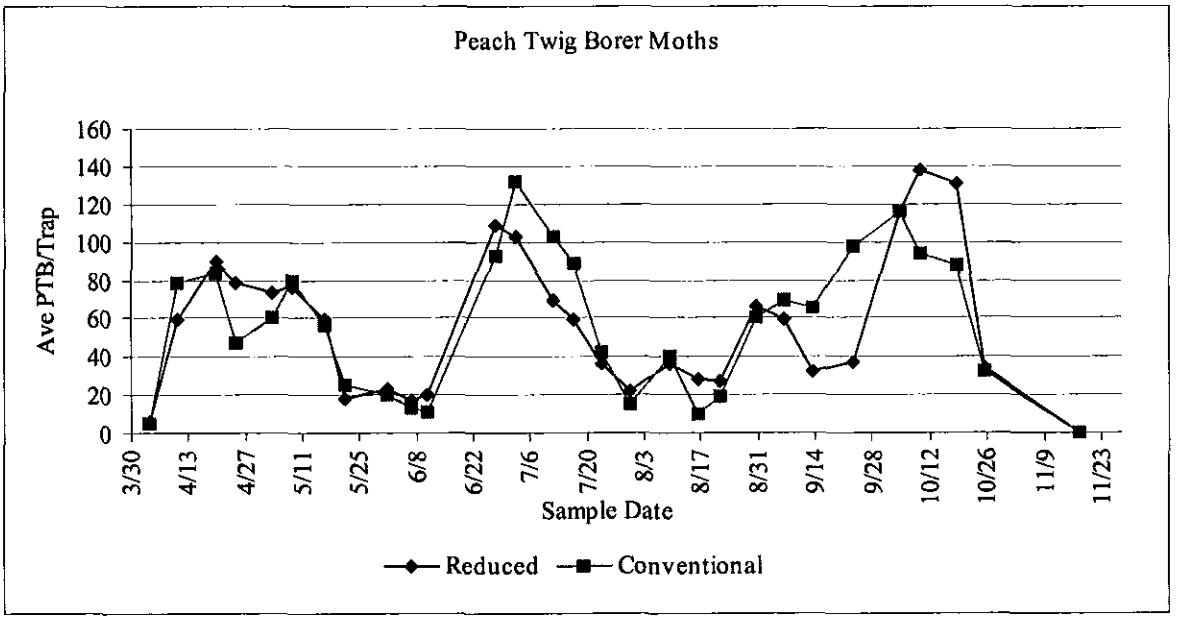


Figure 6. Average number of PTB per trap, where dormant spray was applied, from February to November.

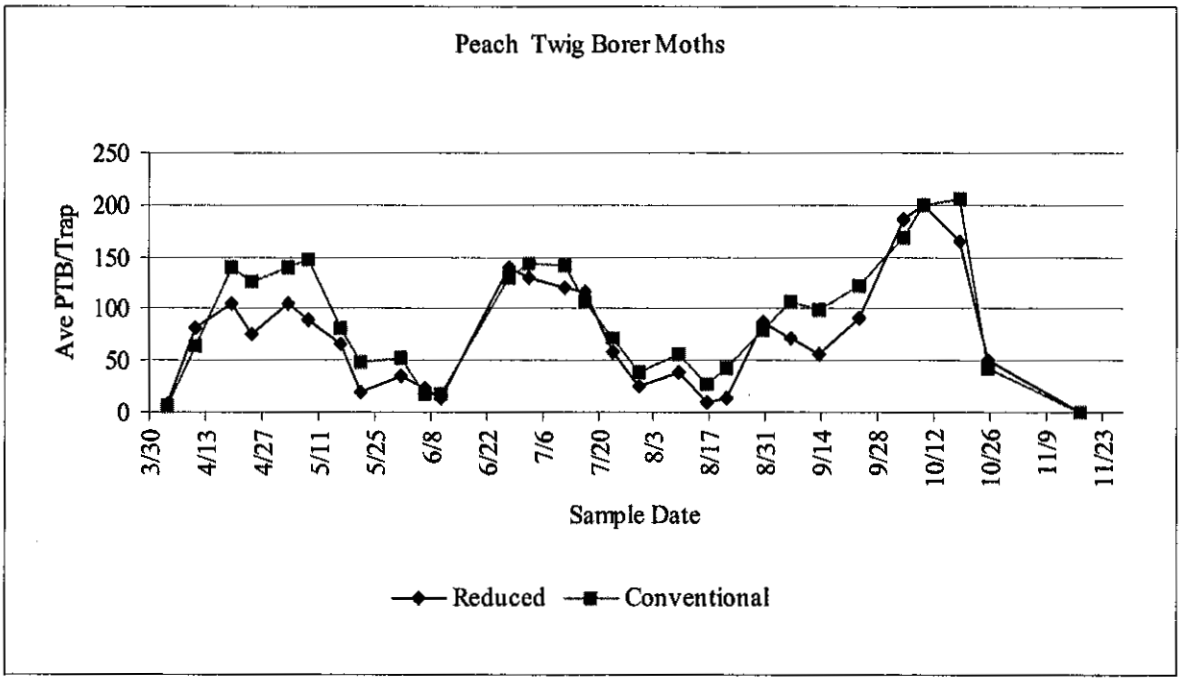


Table 2 shows the number of strikes in May. The number of strikes was very low in the orchard. At this level one should not expect any nut meat damage. The Diazinon® plus oil dormant spray had twice the amount of strikes as the oil alone. However, where no dormant spray was applied, the amount of strikes was almost double to the oil and Diazinon® plus oil sprays.

Table 2. Average number of strikes per tree on May 24, 2002

Management	Dormant Treatment	Average Strikes per tree
Conventional	Diazinon® + Oil	0.15
Reduced Input	Oil	0.08
Conventional	Diazinon® + Oil	0.15
Conventional	No treatment	0.25
Reduced Input	Oil	0.08
Reduced Input	No treatment	0.15

The percent of rejects due to PTB is shown in Table 3. The rejects for 2002 were zero in all dormant treatments. Confirm® was applied in May for PTB control. This spray had no effect in reducing nut meat damage at harvest time.

Table 3. Percent of rejects due to Peach Twig Borer damage.

	Nonpareil				Butte			
	1999	2000	2001	2002	1999	2000	2001	2002
Reduced Input (Oil)	0.06	5.88	0.69	0.00	-----	8.49	0.19	0.13
Conventional (Oil & OP)	0.26	4.40	0.00	0.00	-----	9.11	0.00	0.00
Reduced Input no Dormant	-----	-----	0.25	0.00	-----	-----	0.00	0.13
Conventional no Dormant	-----	-----	0.13	0.00	-----	-----	0.06	0.00

Navel Orange Worm (NOW). Mummy counts showed that all conventional and reduced input management plots had less than one mummy per tree by February 12.

The average number of NOW per trap from both non-dormant and dormant sprayed plots can be found in Figures 7 and 8 respectively. The average number of eggs during the growing season was very low on both dormant and non-dormant treatment. There were more eggs on the dormant than on the non-dormant treatments.

Figure 7. Average number of NOW eggs per trap, where no dormant spray was applied, from February to November.

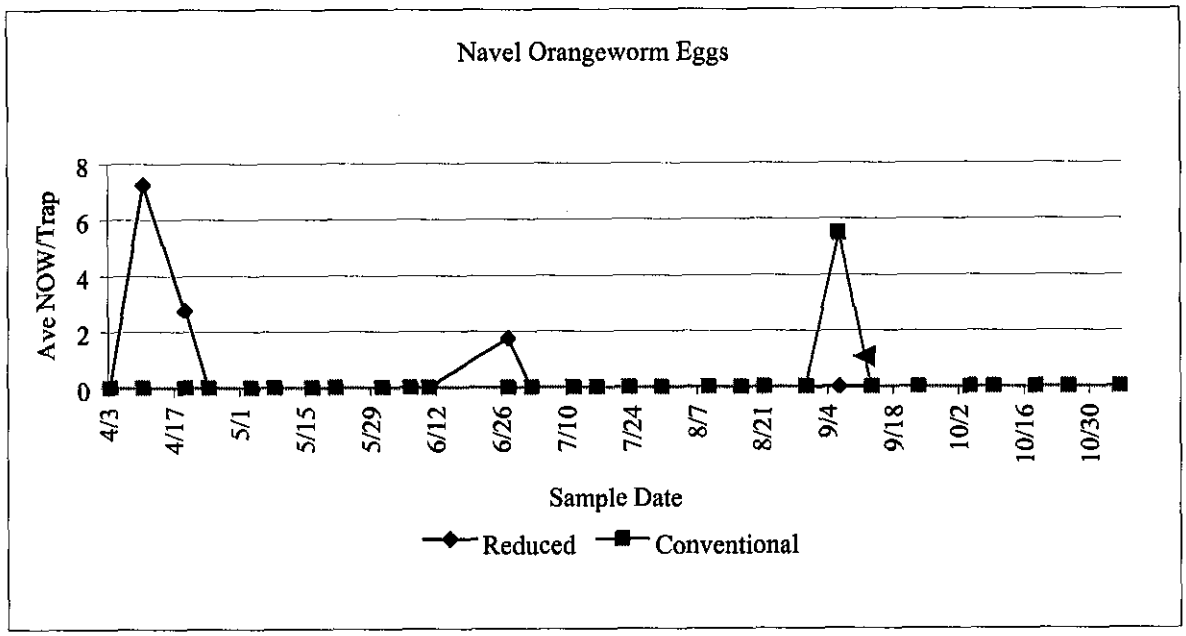
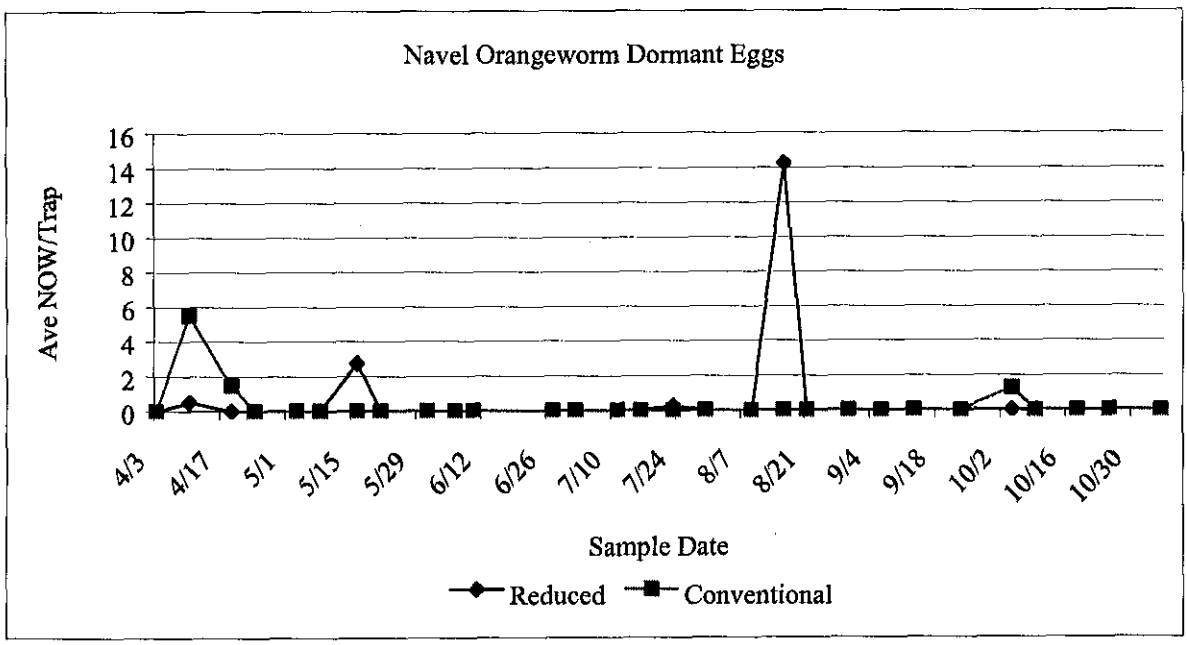


Figure 8. Average number of NOW eggs per trap, where dormant spray was applied, from February to November.



NOW rejects can be found in Table 4. In the Nonpareil the reject levels in reduced input was higher than the conventional. However, the reduced input no dormant was lower than the conventional no dormant. The reject level, nevertheless, were very acceptable for Nonpareil. The reject levels for Butte were about the same in all treatments.

Table 4. Percent of rejects due to Navel Orangeworm damage.

	Nonpareil				Butte			
	1999	2000	2001	2002	1999	2000	2001	2002
Reduced Input	0.12	2.09	0.94	1.13	-----	7.99	1.00	0.00
Conventional	0.19	2.81	0.14	0.25	-----	9.32	1.19	0.25
Reduced Input no Dormant	-----	-----	0.50	0.75	-----	-----	1.19	0.25
Conventional no Dormant	-----	-----	0.44	1.00	-----	-----	0.88	0.29

Mites. The 2002 season was a mite year due to 100°F days during the summer. The mites were kept under control with oils and Agri-Mek® sprays. Table 5 shows mite sprays treatments for 2002.

Table 5. Mite treatment for 2002

Management	Dormant Treatment	Mite Treatment
Conventional	Diazinon® + Oil	oil 4 gal. (3/21) AgriMek® 10 oz. + oil 2 gal.(5/1)
Conventional	No treatment	oil 4 gal. (3/21) AgriMek® 10 oz. + oil 2 gal.(5/1)
Reduced Input	Oil	AgriMek® 10 oz. + oil 2 gal. (5/16) solid
Reduced Input other	No treatment	AgriMek® 10 oz. + oil 2 gal. (5/16) every

The results of these treatments can be summarized with the following statements. One, there were no differences in mite leaf infestation between dormant and non-dormant treatments. Two, mite control due to AgriMek® sprays were effective when solid rows were sprayed as well as when every other row was sprayed. Third, plots that were sprayed with oil in the spring had significantly fewer mites than plots that were not sprayed with oil.

The average number of overwintering mites is found on Table 6. The number of overwintering mites is not significantly different between reduced input, conventional and conventional no dormant. However, when we look at the totals of all dates, the reduced input had the highest amount of overwintering mites.

Table 6. Average number of overwintering female mites per sample

Treatment	1/3	2/6	2/14	2/21	2/28	3/6	3/13	3/20	All dates

Reduced Input	.00a	.05a	1.05a	6.95a	18.40a	16.60b	4.60a	0	4.44a
Conventional	.00a	.25a.	0.30a	1.40a	4.05a	4.40a	3.20a	0	1.26b
Conventional no dormant	.05a	.15a	0.65a	2.85a	6.40a	2.70a	.80a	0	1.26b

The movement of mites from the orchard floor to the tree scaffolds was evaluated by twig samples. No movement of mites was detected in any of the treatments.

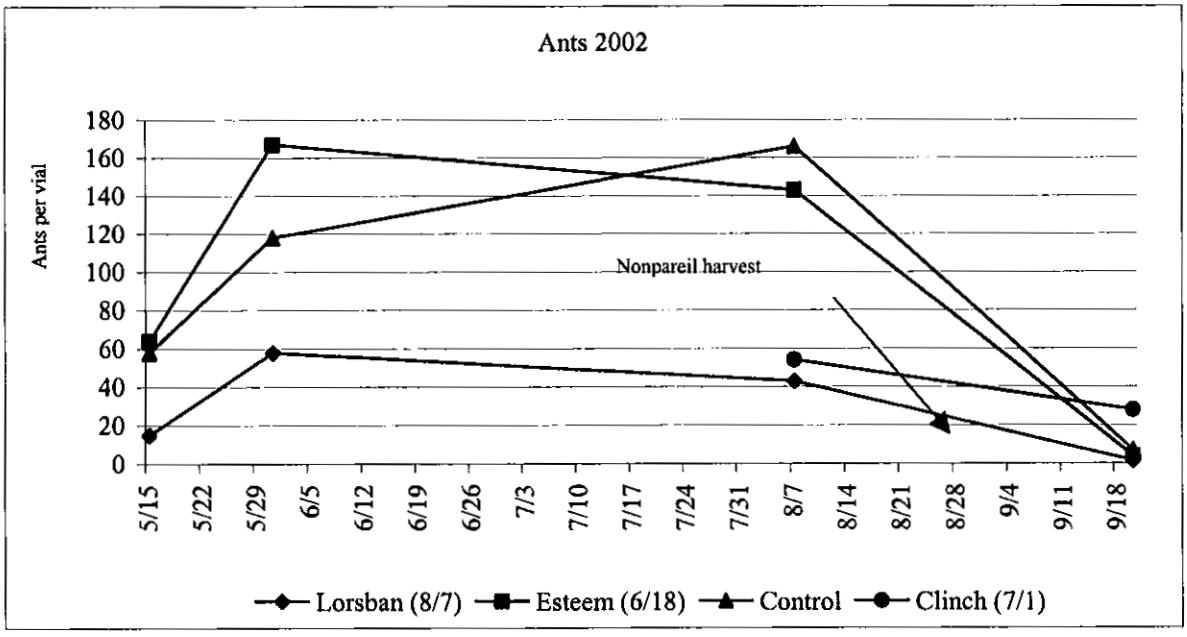
Ants. This insect can cause more damage to almond meats than NOW and PTB. Orchards that are harvested early and/or with a good resident vegetation in the middles are most susceptible to ant damage. The ant treatments can be found in Table 7.

Table 7. Ant treatments for 2002

Treatment	Rate	Application Date
Lorsban®	4 pints per acre	August 7
Clinch®	1.0 pounds per acre	July 1
Esteem®	1.5 pounds per acre	June 18
control	untreated	

The ant population can be found in Figure 9. The lowest population is in the Lorsban® which was also the conventional. This treatment gets treated with dormant oil and Diazinon®. The Clinch® population was also low at pre-harvest.

Figure 9. Average number of ants per sample.



Ants reject levels are found in Table 8. The reduced input had a significantly higher reject level than the conventional. The reason may be due to the Diazinon® in the dormant spray and the Lorsban® applied pre-harvest. There were no differences in ant damage between reduced input and conventional in the Butte variety.

Table 8. Percent of rejects due to ant damage.

	Nonpareil				Butte			
	1999	2000	2001	2002	1999	2000	2001	2002
Reduced Input	3.46	0.14	1.40	4.38a	-----	0.92	0.26	0.31a
Conventional	1.86	0.13	0.27	0.56b	-----	0.51	0.00	0.44a

Shell Seal. During the 2002 season an evaluation was made to try to see if crop load had an affect on shell seal. Trees were selected based on a light, medium or heavy load. Ten trees were selected for each crop load for a total of thirty trees.

Initially, 5/28, 6/10 and 6/27, the nuts were sliced into three sections and examined to see if a difference in shell development could be observed. On the last three dates, 7/19, 7/30 and 8/19, the nuts were examined for any split in the suture. All samples were picked from the tree with the exception of the final sample, which was picked off the ground.

	5/28/02	6/10/02	6/27/02	7/19/02	7/30/02	8/19/02
Light crop load	0.0 a	0.0 a	0.0 a	5.9 a	14.2 a	16.4 a
Medium crop load	0.0 a	0.0 a	0.0 a	5.5 a	13.4 a	15.9 a
Heavy crop load	0.0 a	0.0 a	0.0 a	4.9 a	15.1 a	16.6 a

One hundred nuts were checked for shell seal at the time of harvest.

Treatment	Percent of nuts with open suture
Conventional	81 a
Reduced Input	81 a
Conventional/no dormant	83 a
Reduced Input/no dormant	83 a

Yields. The yields for Nonpareil and Butte are found in Tables 9 and 10 respectively. There were no significant differences between any treatment.

Table 9. Weight per kernel and pounds per acre for Nonpareil.

	Weight per kernel (g)				Pounds per Acre			
	1999	2000	2001	2002	1999	2000	2001	2002
Reduced Input	1.06a	1.32a	1.15a	.96a	701a	716a	1737[ab]	1758a
Conventional	1.04a	1.31a	1.16a	.97a	794a	787a	1814[ab]	1946a
Reduced Input no Dormant			1.16a	.96a			1422a	1774a
Conventional no Dormant			1.15a	.96s			2116b	1983a

Table 10. Weight per kernel and pounds per acre for Butte.

	Weight per kernel (g)				Pounds per Acre			
	1999	2000	2001	2002	1999	2000	2001	2002
Reduced Input	.90a	1.09a	.88a	.75a	760a	896a	2562a	2401a
Conventional	.90a	1.03a	.88a	.77a	804a	832a	2747a	2784a
Reduced Input no Dormant			.89a	.78a			2368a	2606a
Conventional no Dormant			.88a	.77s			2603a	2594a

Orchard Nutrition. There have been no differences in orchard nutrition between conventional and reduced input. There is no reason to see a difference since both management styles have been managed the same. The nutrition status of both management styles is found on Table 11.

Table 11. Tree nutrient levels for 1999, 2000, 2001 and 2002 in the conventional and reduced input programs.

	Reduced Input				Conventional			
	1999	2000	2001	2002	1999	2000	2001	2002
N-Total (%)	3.25	2.81	2.71	2.56	3.26	2.82	2.85	2.65
P-Total (%)	0.18	0.15	0.14	0.12	0.18	0.16	0.14	0.13
K-Total (%)	1.95	1.87	1.99	1.52	1.88	1.81	1.88	1149
Na (ppm)	109	239	244	174	110	203	277	177
C1 (%)	0.07	0.11	0.11	0.16	0.08	0.03	0.12	0.17
B (ppm)	34	36	35	29	34	36	35	30
N-Total (%)	2.3-2.6							
P-Total (%)	0.1-0.3							
K-Total (%)	1.2-1.8							
Na (ppm)	Excess over 2500							
C1 (%)	Excess over 0.3							
B (ppm)	30.65							

Appendix A

Dormant

Conventional Dormant	Diazinon® Oil	5 pints 6 gallons	12/18/02	
Conventional No Dormant	Nothing		12/18/02	
Reduced Dormant	Oil	6 gallons		
Reduced No Dormant	nothing			

May/Hull Split

Conventional Dormant	Imidan®	5.33 lb	7/9/02	solid, soft shells only
Conventional No Dormant	Imidan®	5.33 lb	7/9/02	solid, soft shells only
Reduced Dormant	Confirm®	16 ounces	5/13/02	solid, hard* and soft shells
Reduced No Dormant	Confirm®	16 ounces	5/13/02	solid hard* and soft shells

Mites

Conventional Dormant	oil AgriMek® oil	4 gallons 10 ounces 2 gallons	3/21 and 3/28/02 5/1/02 5/1/02	solid
Conventional No Dormant	oil AgriMek® oil	4 gallons 10 ounces 2 gallons	3/21 and 3/28/02 5/1/02 5/1/02	solid
Reduced Dormant	AgriMek® Oil	10 ounces 2 gallons	5/16/02	solid
Reduced No Dormant	AgriMek® oil	10 ounces 2 gallons	5/16/02	Every other row**

Ants

Conventional Dormant	Lorsban®	4 pints	8/7	
Conventional No Dormant	nothing			
Reduced Dormant	Esteem®	1.5 pounds	6/18/02	
Reduced No Dormant	Clinch®	1.0 pounds	7/1/02	

*Error in spraying the hard shells

**Error in spraying

Acknowledgements

We wish to thank Thomas Vetsch of Vetsch Farms of California, Inc. for providing and maintaining the study site, and for providing labor when needed. We appreciate the donation of predatory mites by Matt Billings of Sterling Nursery, and Clinch® and financial support from Novartis. This study was supported by a grant from the California Almond Board Pest Management Alliance. Thank you for your support.

Task #4: Stanislaus County Almond Pest Management Alliance Project
Year Four Final Report

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Objectives of the Stanislaus County Almond Pest Management Alliance project:

- To scientifically evaluate the long-term effectiveness and economic viability of less broadly toxic pest management programs.
- To extend gained information to the almond industry.
- To demonstrate IPM monitoring techniques and decision-making processes.

We have completed our fourth season in the Stanislaus County PMA trial. The original three pest management regimes were maintained similar to the first three years (grower's standard practice and two "reduced risk" treatments). The only difference in 2002 was that Omite was used for mite control in all plots. Because reject levels have been very low for all pest management regimes throughout the trial, a fourth, "untreated" program was added in 2001. Each pest management program is replicated three times within a 120 acre Nonpareil: Carmel orchard west of Modesto. Each plot is approximately 13.5 acres in size. The treatments are:

1) ***Grower's Standard Practice***: (fairly common in the Northern San Joaquin Valley).
- A **dormant** application of **Asana®** (a pyrethroid), 6 gallons of **oil**, & 8 lb. **Kocide®**.
- A **May spray** with an organophosphate (**Lorsban**).
- **Lorsban** for **ant** control.

2) ***Soft Program #1***:
- A **dormant** application of **copper & oil** (no insecticide).
- A **"bloom" spray of Success®** at ~ 30% PTB emergence (piggy-backed with fungicides).
- A **May spray** of **Confirm®**.
- **Clinch®** (Abamectin) bait for **ants** if monitoring deems necessary.

3) ***Soft program #2:***
- A **dormant** application with **oil** only.
- Two **"bloom"** applications of **Bt** (@ ~20% PTB emergence & ~ 80% emergence).
- Two **May sprays** of **Bt** (300-350 & 450-500 DD after biofix).
- **Esteem®** bait for **ants** if monitoring deems necessary.

4) ***"Untreated":*** only mites and ants are controlled if necessary.
- No dormant copper, oil, or insecticide application.
- No bloom insecticide applications.
- No May or hull split sprays.
- **Esteem®** bait for **ants** if monitoring deems necessary.

Overwintering nuts ("mummies") were removed and destroyed in all treatments to reduce overwintering naval orangeworm. Cover crop management, fertilization, and fungicide treatments were the same for all treatments other than no dormant copper was applied in "soft program #2" and the "untreated" areas.

Monitoring:

Each plot had two PTB pheromone traps, two San Jose Scale pheromone traps, four sticky tape traps for S.J. scale crawlers, and two NOW egg traps for a total of 120 traps in the trial. Peach twig borer and naval orangeworm traps were checked twice weekly while San Jose scale pheromone traps were monitored bi-weekly throughout the season (March through September). In addition, mites and mite predators were monitored bi-weekly with the presence / absence leaf sampling technique. Ants were monitored twice using hotdog bait. In the fall, spurs were sampled to monitor San Jose scale populations.

Results:

Pest and beneficial arthropod populations were very low throughout the season, regardless of treatment. There were no differences between treatments in peach twig borer trap catches, naval orangeworm egg laying, spider mite numbers, San Jose scale trap catches, or scale parasitoids. Spur samples collected after each growing season have shown almost no San Jose scale present in any of the treatments. Due to our error, we were only able to secure harvest samples from one of the three treatment replications. Analysis of these samples showed only 1 out of 500 kernels (0.2%) with ant damage in Treatment #1 and 2 out of 500 kernels (0.4%) with ant damage in the Treatment #2. All other samples were zero for ant, NOW and PTB feeding damage.

Season Total of Peach Twig Borer per Trap
Stanislaus County PMA Trial, 2002

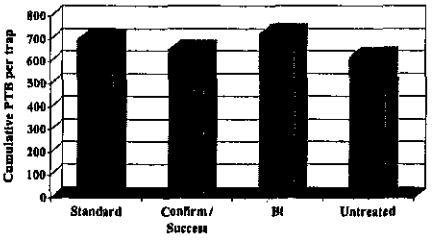


Fig. 2 San Jose Scale & Scale Parasitoid Numbers as Related to Treatment
Stanislaus PMA 2002

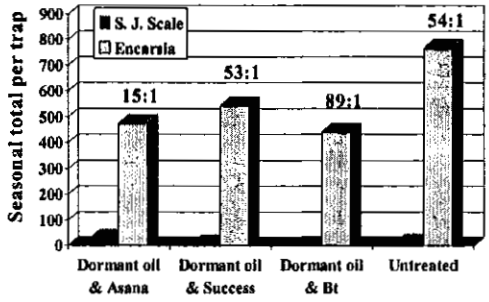


Table 1. Harvest Evaluation of Nonpareil Almonds Farmed Under Four Pest Management Programs.

Stanislaus County Almond PMA Trial, 2002

Treatment	% NOW	%PTB	% Ant	Total % Rejects
Standard	0	0	0.2	0.2
Success	0	0	0.4	0.4
Bt	0	0	0	0
Untreated	0	0	0	0

Costs Per Planted Acre.

Stanislaus County Almond PMA Project, 2002

(Includes $13.65 per acre application costs.)

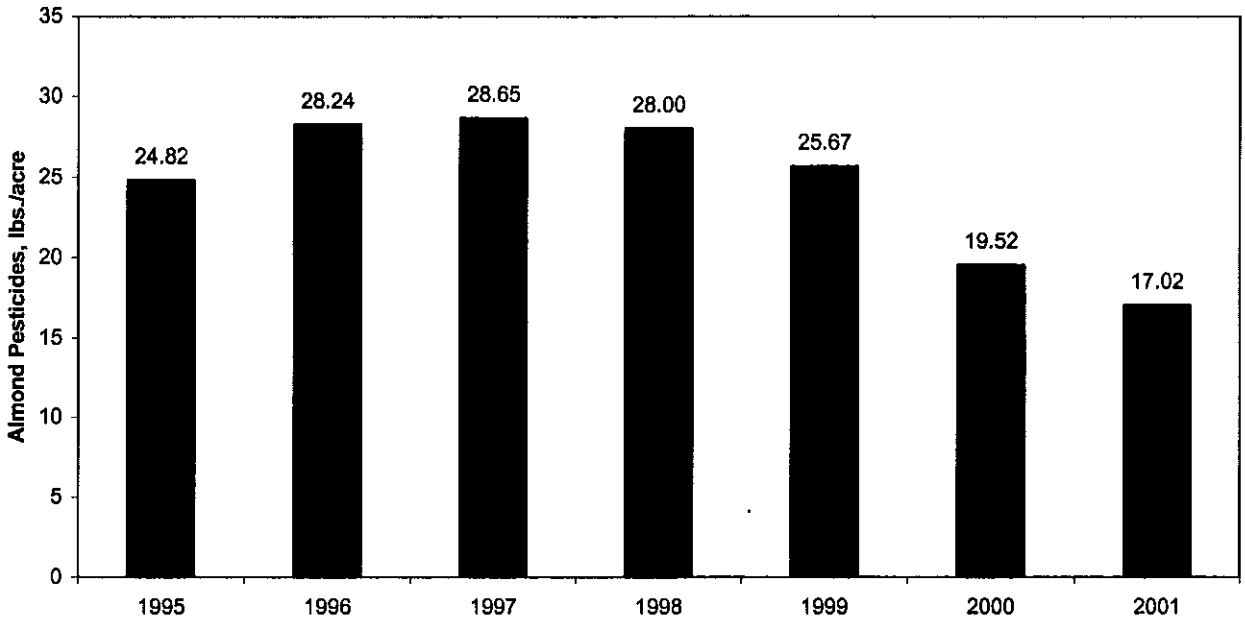
	Spray Timing	2001	2002	Average
Standard	Dormant	56.96	56.33	56.65
	May	41.56	37.81	39.69
	Mites	24.27	20.25	22.26
	Total	***122.79***	***114.39***	***118.60***
Confirm/ Success	Dormant	48.96	48.96	48.96
	Bloom	23.46	41.10	32.28
	May	40.47	50.15	45.31
	Mites	38.53	18.78	28.66
	Total	***151.42***	***158.99***	***155.21***

Bt	Dormant	30.38	30.38	30.38	
	Bloom	35.21	51.53	43.37	
	May	51.48	51.52	51.50	
	Mite	33.57	18.89	26.23	
	Total	***150.64***	***152.32***	***151.48***	
Unsprayed	Mite	33.57	18.89	26.23	
	Total	***33.57***	***18.89***	***26.23***	

TASK 5: PESTICIDE USE REPORTS

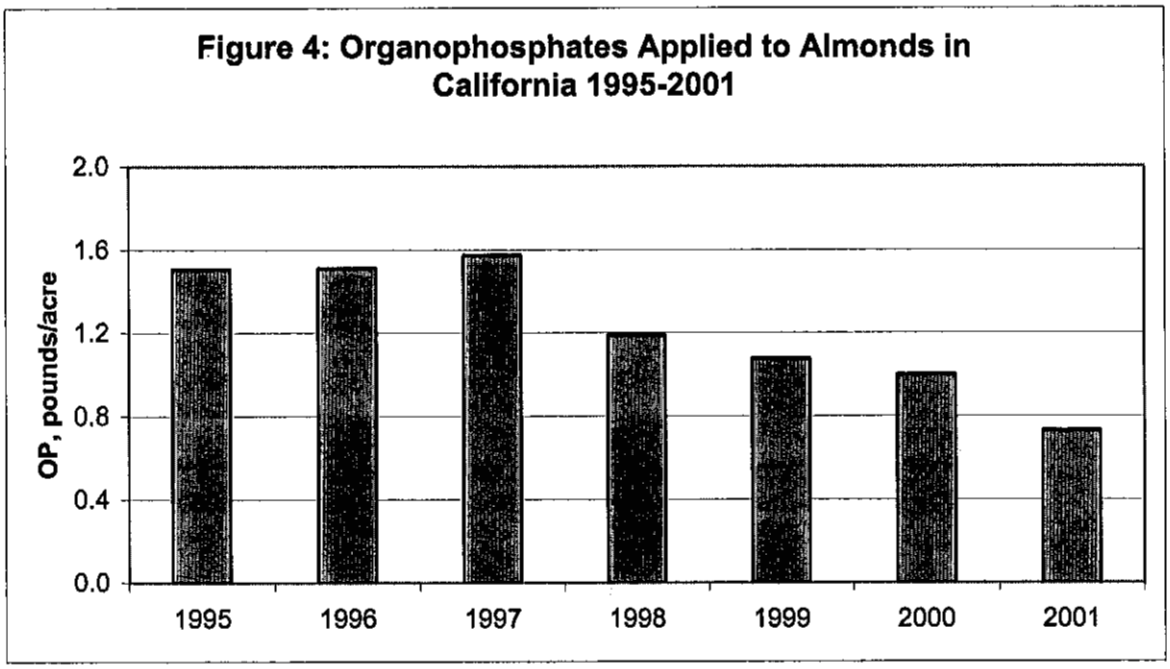
According to Pesticide use reports accessed at the California Department of Pesticide Regulation website, http://www.cdpr.ca.gov/docs/pur/, pesticide use in California almonds continues to decline for the 4th year on a pounds per acre basis. Between 1999 and 2000, almonds statewide reduced pesticide use by 3 million pounds, the greatest reduction of all commodities. Between 2000 and 2001, the trend continued, with a 1.5 million pound reduction.

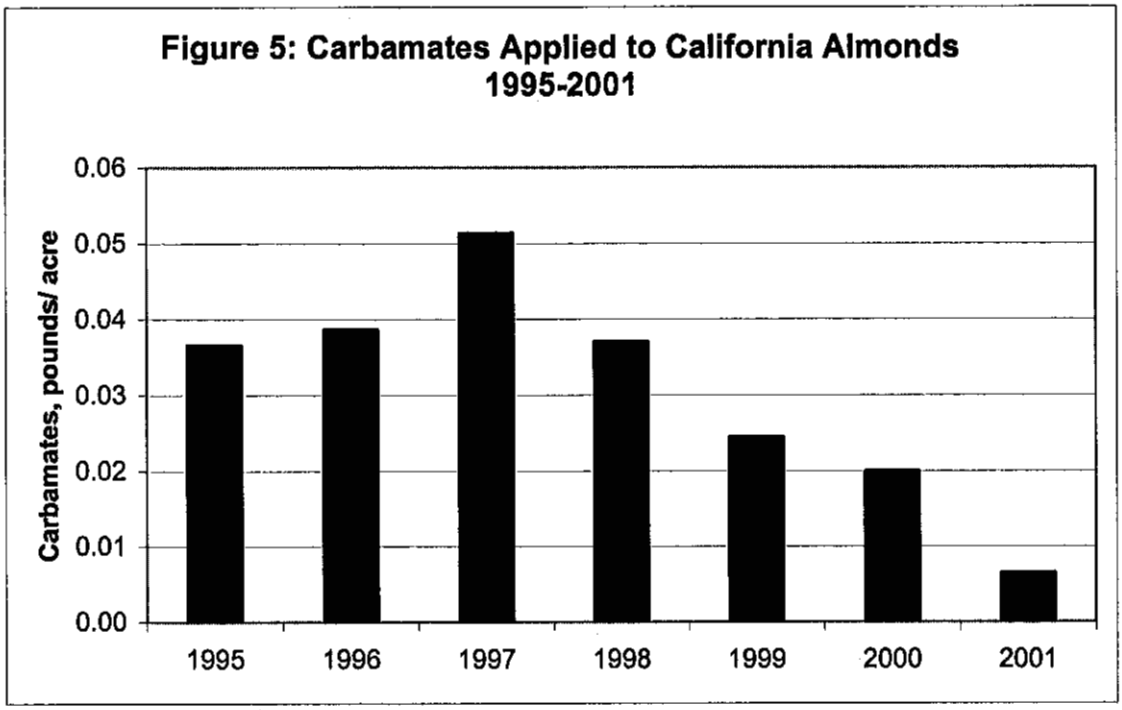
Figure 3: Total Pesticides Applied to Almonds in California 1995-2001



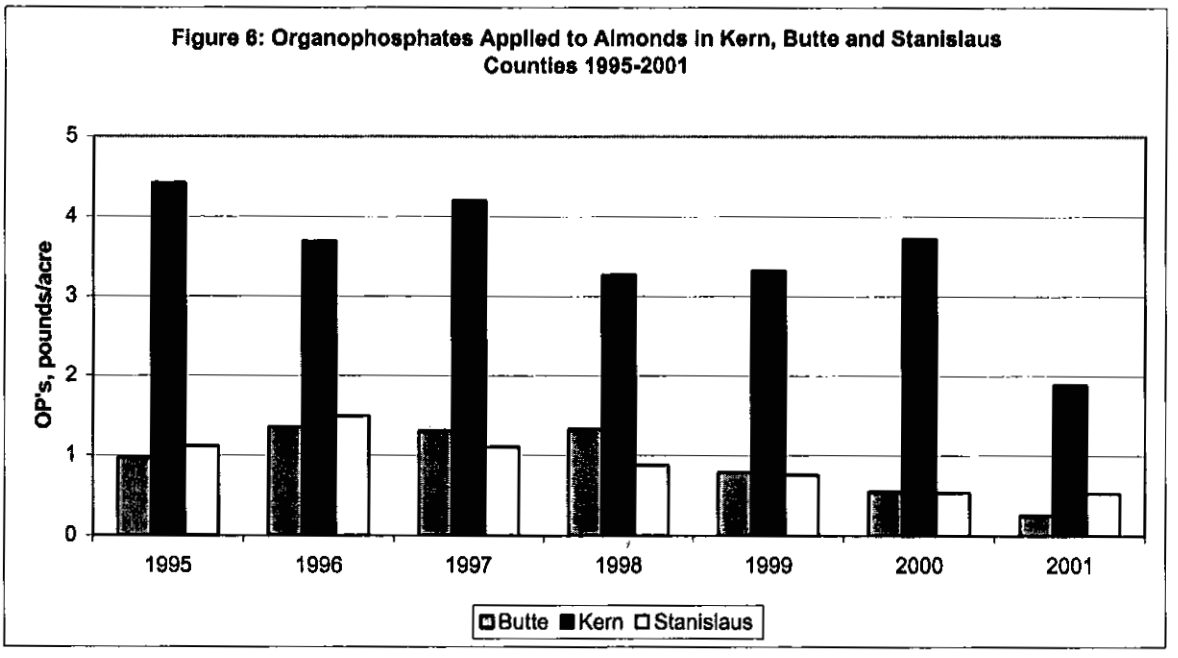
This section summarizes pesticide use in almonds statewide as well as in the three counties containing PMA sites. Due to yearly acreage fluctuations, all amounts are reported as pounds per acre.

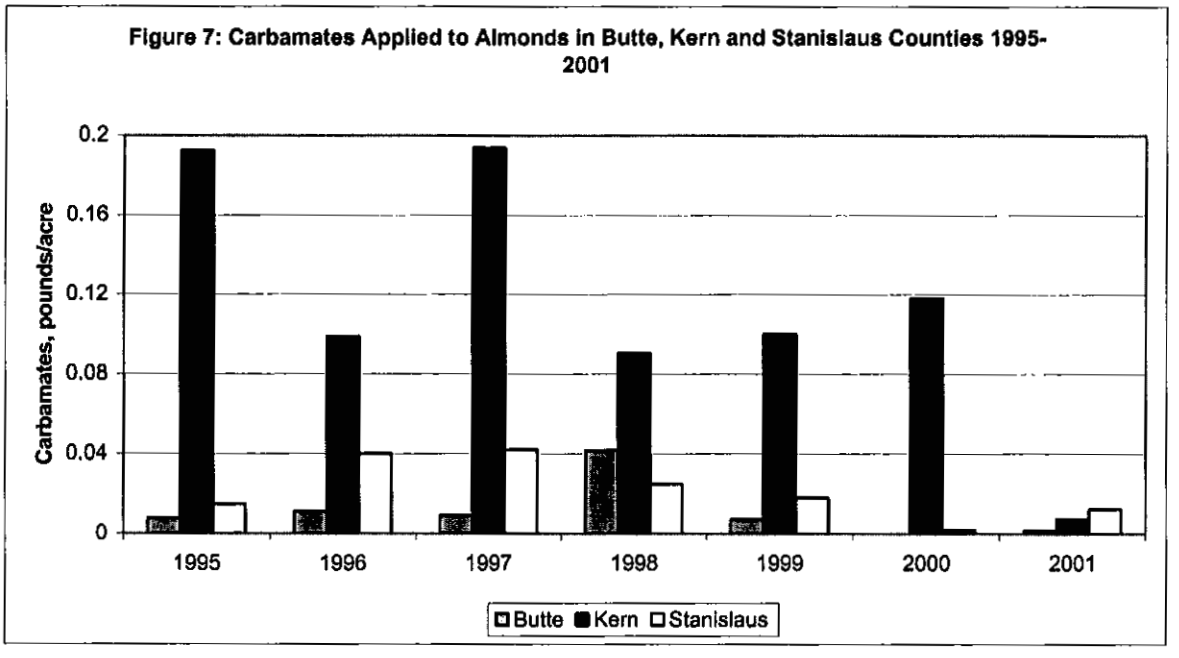
Of greatest regulatory and environmental concern are cholinesterase inhibitors, pesticides that are in the categories of organophosphates and carbamates. Statewide, there has been a marked decline in pounds/acre of organophosphates used on almonds in California, and an even steeper decline in carbamate use. Organophosphates identified for these calculations are azinphos-methyl, chlorpyrifos, diazinon, fosetyl-al, malathion, methidathion, naled, parathion, and phosmet. The carbamates are carbaryl and methomyl.



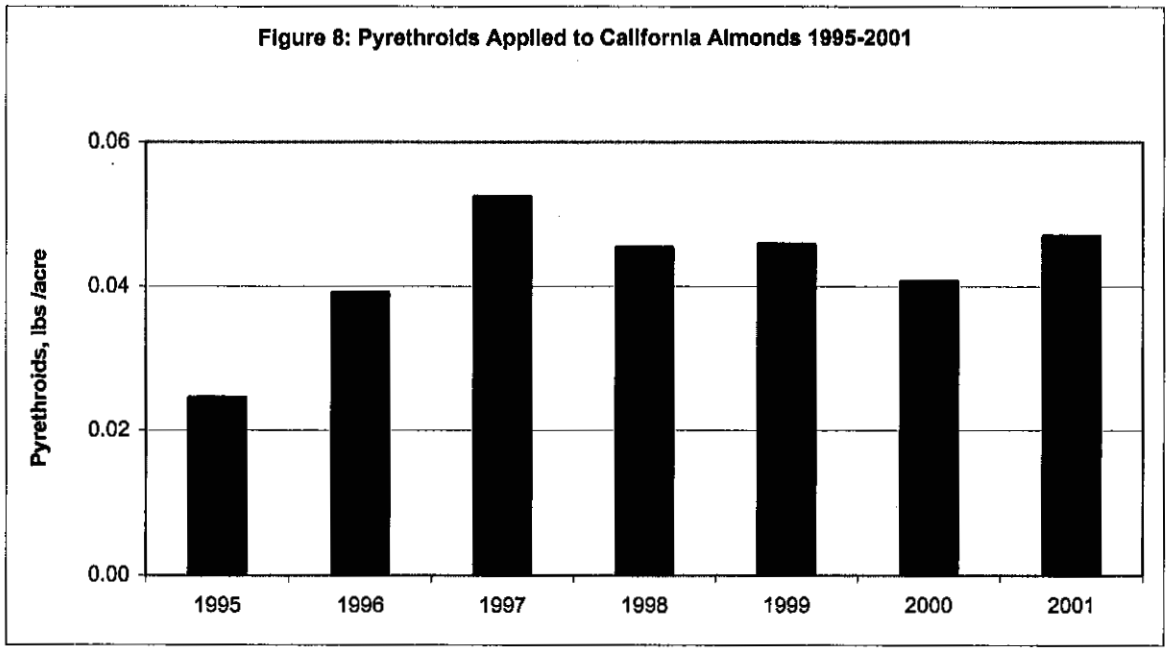


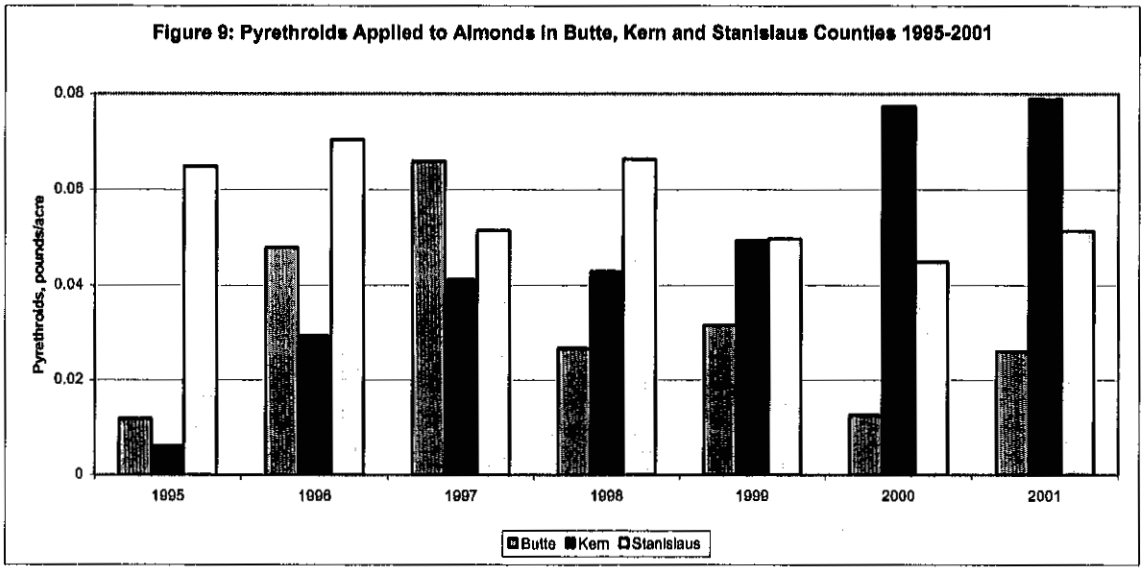
However, when OP and carbamate use is broken down by county, the decline in OP's is not as marked, but the sharp drop in carbamate use is obvious.





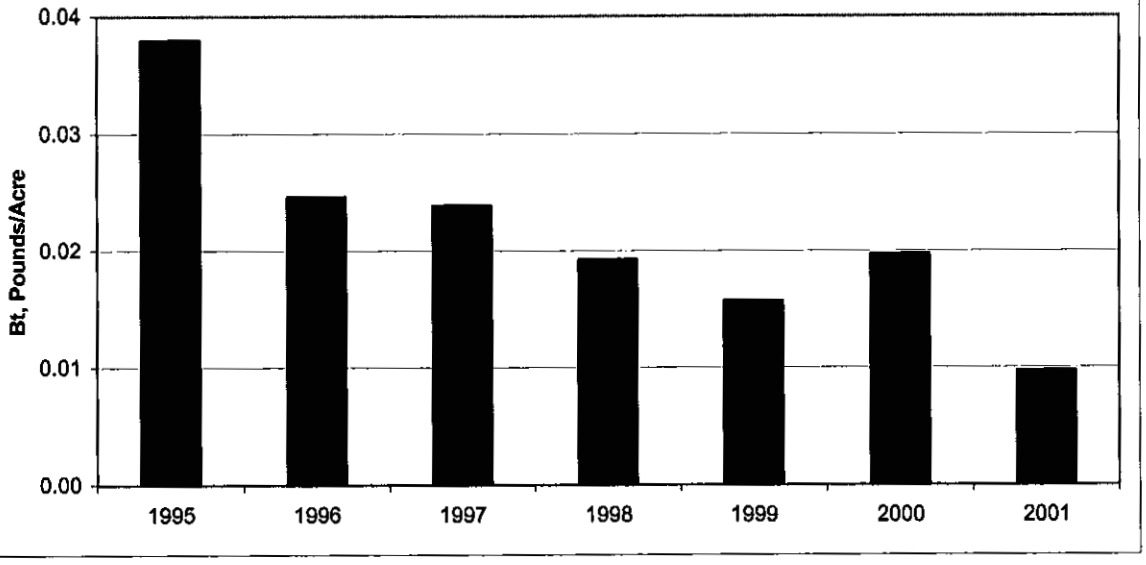
Pesticides in the category of pyrethroids include esfenvalerate and permethrin. In the future, projects such as the almond PMA should target these pesticides specifically for reductions in use, since pounds/acre have either remained the same in recent years or have had only a slight decline. These results occur in California as a whole, and also in the three specific counties we are looking at.

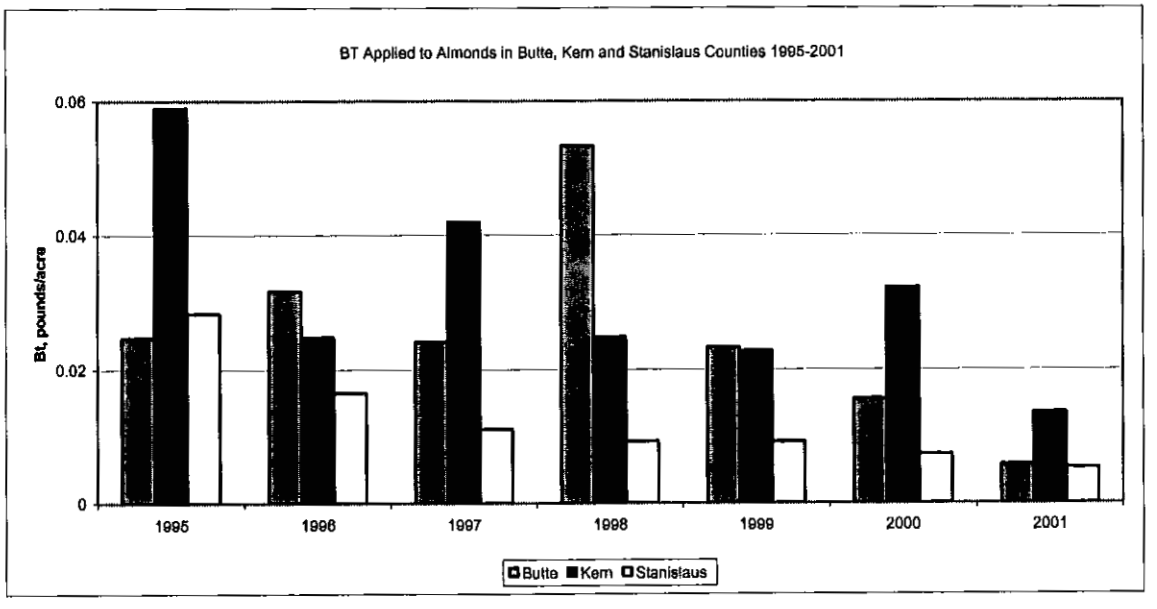




The many forms of *Bacillus thuringiensis* are very safe, naturally occurring bacteria that can be used to control the larvae of many common pests. Maybe more information extension is needed to increase the use of these environmentally friendly pesticides, as their use has decreased in recent years.

Figure 10: Bacillus thuringiensis Applied to California Almonds 1995-2001





Task 6: Education, Outreach, and Extension

Education, outreach, and the extension of information are the basis for California almond growers to gain confidence in reduced risk practices. Conducting field meetings, workshops, and providing information via newsletters, status reports, and articles play an important role. In addition, in 2002, the Almond PMA wrote monitoring protocols for PTB, NOW, SJS, mites, ants, and dormant sampling. These protocols are a work in progress, however other groups have already benefited from using them, such as the Nature Conservancy.

Attendance at field day meetings reflects the optimism and success the PMA program. Each region organizes at least two meetings per year. One meeting is conducted in the spring and the other is a dormant/winter meeting. The winter meetings coincide with the time of the season where many insecticidal sprays are being applied and therefore are especially relevant for demonstrating techniques for determining whether an orchard requires any dormant treatment. Stanislaus held a winter meeting Nov. 28, 2001 that was attended by 130 growers and PCA's. Butte County's dormant spray workshop was Jan. 11, 2002 and drew about 80 interested parties, and Kern County hosted a meeting in Bakersfield on Nov 26, 2002.

The PMA sites also hold field meetings during the summer months with pest management demonstrations and hands-on displays. These meetings are very valuable and are usually very well attended because they show first- hand the successes of the reduced risk treatments and the grower is available to talk about his experiences in the project. Less toxic alternatives to traditional in-season insecticides are explained as well as insect identification and using weather data to time sprays and forecast insect population peaks. The Kern site held a meeting on May 1, 2002, the Stanislaus site on May 2, and the Butte site's meeting was May 29.

Newsletters are an important component for relaying updates and informing growers, some who may not be active in the PMA, on issues regarding almonds in California. Many of these newsletters are regional, thereby relaying pertinent information to local growers. Some newsletters are sent via mail, others are status reports or quarterly reports reported to the Department of Pesticide Regulation that can be accessed via the Almond PMA website at http://lookercomm.com/almondPMA/almondpma.htm. News articles and news coverage relating to the Almond Pest Management Alliance benefit the program by reaching a large audience in popular agricultural periodicals.

Many growers and those involved with the almond industry subscribe to or have access to agricultural periodicals. The Almond PMA makes good use of this medium for educating and updating many of those growers who do not actively participate in the Almond PMA. Through this extensive outreach effort, we hope to gain interest in the program, thereby increasing the numbers of growers voluntarily adopting reduced risk techniques in some capacity.

An article in Western Fruit Grower Magazine in November, 2001, explains that the reduced risk approach to growing almonds results in a high quality crop, but that the softer products are still often more expensive than conventional pesticides. An article in Ag Alert, the California Farm Bureau's newsletter, June 26, 2002, includes information from Rich Coviello's ant control presentation at the Modesto Field Day on May 2, 2002. An article in the August California Farmer highlighted dormant season pesticide runoff problems and the educational effort aimed at reducing this type of environmental contamination. The Spring 2002 Almond PMA Newsletter was sent to 6,500 growers, PCA's and other interested parties. It contained updates on the regional projects and was also posted to the Almond PMA website. The Department of Pesticide Regulation released a report on October 16, 2002 detailing a third consecutive year of reduction in pesticide use statewide. The report highlight almonds as one of the crops having significantly reduced pesticide use, with a decrease of more than 1.5 million pounds from 2000 to 2001.

DISCUSSION

Since the Almond PMA was first formed in 1998, environmental issues affecting the California almond industry have increased in number and complexity. The Almond PMA was created to conduct scientific research into the viability of reduced-risk approaches to pesticide use in almond orchards. Pesticide use continues to be an area of major concern to the public and governmental regulatory agencies. In its fourth year, the Almond PMA has demonstrated the usefulness and effectiveness of a voluntary industry-driven collaborative approach on two levels: It has helped build an effective network of information gathering and sharing throughout the diverse and far-flung California almond industry, while building a knowledge base of scientifically valid research that will enable almond growers to make key informed decisions that affect pest management in an environmentally responsible manner.

The key pests targeted by the Almond PMA remain the same: navel orangeworm (NOW), peach twig borer (PTB), San Jose scale, mites, and ants. And the three project orchards have remained in the same locations of Butte County, Stanislaus County and Kern County.

The consistency of this project through four growing seasons has allowed almond growers to become familiar with the goals of the project and to understand how each particular demonstration orchard has been treated. Growers in all regions have expressed a common theme: They want to reduce their costs and they want to reduce regulatory burdens which impact upon their farming operations.

The Almond PMA has provided a forum for discussion by growers, PCA's and UCCCE farm advisors about the meaning of a "reduced risk" approach to pesticide use. While use of a "softer" pesticide may mean "less risk" to the environment, does its use necessarily mean "less risk" to a grower who is not sure if the "softer" pesticide will deal effectively with pests that can impact a grower's returns? The Almond PMA does not guarantee that any final answers will be provided during this project but the value of the project lies in the fact that these types of questions are being raised and addressed by the almond industry.

The Almond PMA has received many compliments through its four years for the effectiveness of its outreach efforts. Field days are held each spring and fall in each of the three regions. These field days allow growers and PCAs to ask questions about the project. A newsletter is mailed each spring and fall to growers, PCAs and interested persons throughout the state. Additionally, articles placed in industry publications as well as general circulation newspapers. All of these outreach efforts have combined to raise industry and public awareness of the project.

Now that a baseline of awareness has been established, the next step for the PMA and the industry is to take an approach that rather than simply informing growers about a preferred practice, facilitates farmer learning about the how and why of a preferred practice. The reduced risk approaches that the PMA has promoted for four years require intensive monitoring and an understanding of what is happening in a particular orchard. This requires a different type of learning- a systems approach to learning that will require leadership from such organizations as the Almond PMA.

At a time when state budget cuts are increasingly impacting the UCCE and reducing its ability to conduct outreach activities, it is becoming clear that organizations such as the Almond PMA and Almond Board of California will have a larger role to play in educating growers about pest management issues. As the PMA moves into its fifth and final year of funding from DPR, it is evident that the almond industry and its allied organizations need to consider how to keep up the momentum the PMA has provided.

Project Summary Form

1) Proposal Title
To Promote a Reduced Risk System of Almond Production Through Alternative Practices

2) Principal Investigator
Chris Heintz

3) Alternative Practices
Pheromone traps and degree-day models to time sprays. Bt and insect growth regulators instead of OP pesticides. Predatory mites and oil sprays instead of miticide sprays. Cover crops planted to decrease runoff and increase water penetration. Winter sanitation to reduce need to spray for navel orangeworm.

4) Summary of Project Successes [I think Sara has some better info than to use 99-00]
California almonds had largest pesticide reduction of all crops in 1999-2000 with 3 million lbs, and still large reduction between 2000 and 2001 at 1.5 million lbs. The PMA has shown that growers can harvest economically successful crops with zero to one pesticide spray. Less toxic fungicides used.

5) Number of Participating Growers: 3
6) Total Acreage in Project: 329
7) Project Acreage Under Reduced Risk: 160
8) Total Acres of Project Crop: 1410
9) Non-Project Reduced Risk Acres: 955
10) Number of Participating PCAs: 3
11) Cost Assessment
The average cost for the grower standard treatment blocks was $96/acre and the average costs for the reduced risk treatment blocks was $101.25/acre. Similar costs, but no more damage seen to the crop in reduced risk.

12) Number of Field Days: 3
13) Attendance at Field Days: about 250
14) Number of Workshops & Meetings: 3
15) Workshop Attendance: 150
16) Number of Newsletters: 1
17) Number of Articles: 4
18) Number of Presentations: 3
19) Other Outreach Activities

Almond monitoring protocols for reduced risk systems refined and passed on to other interested parties.

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Contract Number

Project ID

DPR ID#

Contract Manager

25th June 2001 Version